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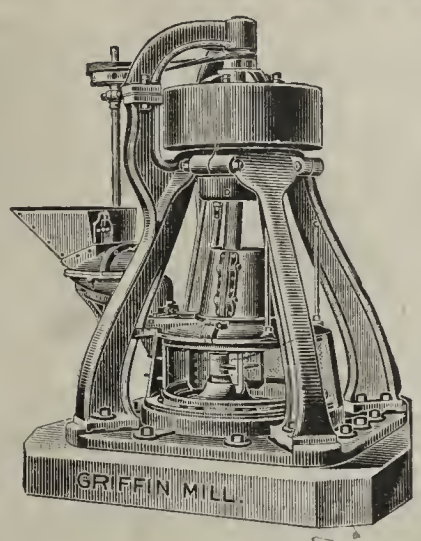

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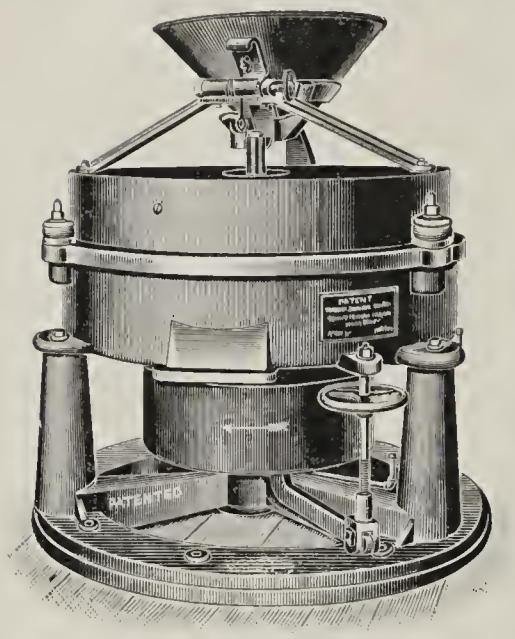

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ENGINEERING NEWS

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CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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Chicago, January, 1900.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

The next annual meeting of the International Mining Congress will be held at Milwaukee, Wis., June 19 to 23 inclusive. For information address T. J. Sullivan, secretary, 40 Sentinel Bldg., Milwaukee, Wis.

THE CHICAGO DRAINAGE CANAL.

The World's Columbian Exposition brought the city of Chicago prominently before the nations of the earth, while the opening of the Chicago Drainage Canal on January 17 has awakened a great interest in the city in every commercial center of the world.

The great engineering feat which Chicago has brought to a successful termination involved the expenditure of over thirty-three million dollars to January 1, 1900. Seven years labor, during which time 43,478,659 cubic yards of solid rock and glacial drift were excavated, and 380,050 cubic yards of retaining wall laid in cement mortar constructed.

This waterway extends from Lake Michigan, via the Chicago river, following the course of the south branch 4 miles, where the river divides into south and west branches, pursues the west branch and connects, 6 miles from Lake Michigan, at Robey street with the artificial cut, known as the main channel, 28 miles to Lockport, where the controlling works are located. The main channel pierces the rock formation, designated as "the Chicago divide," the southern slope of which drains into the Mississippi valley, while the northern slope drains into the St. Lawrence river through the great lakes. The piercing of the divide by the main channel reverses the flow of the Chicago river and causes it to drain into the Mississippi water shed instead of the St. Lawrence as heretofore.

The Desplaines river division channel south of the divide and parallel with the main drainage channel provides for the control of the flood waters of the Desplaines river and involved the excavation of a 13-mile channel.

Nineteen miles of levee were built to separate the waters of the Desplaines water shed from the main drainage channel. A concrete spillway dam at the head of the Desplaines river confines the flood waters of the Desplaines valley within its course up to a volume of 300,000 cubic feet per minute, (the flow of the Desplaines varies from less than one cubic foot to 800,000 cubic feet per minute); the surplus in excess of 300,000 passes over the spillway into the main drainage channel and will reverse the flow of the main channel and Chicago river temporarily and discharge into Lake Michigan until improvements under way at Joliet are completed to receive and care for the excess.

The drainage trustees are compelled by law to maintain a flow of 200 cubic feet per minute for each 1,000 inhabitants in the drainage district and a minimum flow of 300,000 cubic feet per minute at a velocity of not more than three miles per hour, which the United States authorities have limited to one and one fourth miles per hour. The Chicago river tunnels are to be lowered to provide for a 20-foot channel.

The drainage district subject to taxation to pay for and maintain the canal embraces the city of Chicago and 43 square miles in Cook County outside of the city proper, in which $240,000,000 is listed for taxation at about one-tenth of real values.

Great credit is due to Isham Randolph, chief engineer, under whose supervision the greater part of the work has been carried on since June, 1893, and to T. T. Johnson, assistant chief engineer, and to the efficient staff of assistants engaged on the work: Geo. M. Wisener, engineer in Chicago of the concrete bypass as well as to Lyman E. Cooley, the first chief engineer of the work and strongest promoter for the great enterprise. Potent forces are now at work to extend the usefulness of the canal by the aid of the United States government for a 14-foot waterway from Chicago to New Orleans in the interest of commerce.

The Iola Portland Cement Co. is being delayed by the inability of machinery manufacturers to deliver their goods owing to scarcity of iron.

Five natural cement mills located in Silver Creek township, Clark county, Ind., will market the combined output through a joint selling agency. The following mills are interested: The Kentucky and Indiana, the Globe, the New Albany, the Banner and the Clark County. The combine has been incorporated under the name of the Central Cement Co. and the product of the five mills is to be sold by the general manager. The mills have a capacity of 1,000 bbls. a day. It is not the intention to antagonize any of the other mills, but simply to handle the output of the five mills more economically.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	NOVEMBER.				ELEVEN MONTHS ENDING NOVEMBER.			
	1898.		1899.		1898.		1899.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	12,435,420	45,233	16,042,700	65,395	91,933,872	324,154	76,844,256	297,663
Belgium..	20,581,557	59,864	30,465,241	95,394	247,688,991	738,631	233,581,529	693,869
France	3,360,000	8,527	595,200	2,399	6,322,400	19,820	6,253,045	22,230
Germany.....	38,051,917	126,818	51,784,742	186,900	374,364,328	1,261,175	440,227,525	1,558,269
All Other Europe ...	198,400	1,050	4,458,970	13 871	20,100,070	36,863	26,465,863	68,692
British North Am...	314,950	1,148	111,350	633	1,884,000	8,712	1,715,440	8,668
Other Countries.....	.....	.....	5,900	20	5,200	25,432	815,500	4,013
TOTAL	74,942,244	242,640	103,463,703	364,612	742,298,861	2,414,787	785,903,158	2,653,404
Domestic Exports of Cements, bbls.	2,440	5,258	3,479	7,871	33,263	66,716	73,180	151,061

There were 2,595,864 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on November 30, 1898, valued at $8,120, against 1,922,675 lbs., valued at $6,258, in November, 1899.

Imports of asphaltum or bitumen for November, 1898, were 7,875 tons valued at $26.126; November, 1899—6,216 tons valued at $25,575. For eleven months ending November, 1898, 62,903 tons valued at $185,570, for eleven months ending November, 1899—91,814 tons valued at $289,902.

APPLICATION OF THE MONIER SYSTEM IN HYDRAULIC CONSTRUCTION.

By E. Lee Heidenreich.

Monier pipes for sewers or water conduits are either constructed in place by a continuous process or built at factories in about 10-ft. lengths. The pipes may be circular or oval and of any size. If they are not over 20 ins. in diameter they are provided with bells and sockets like common clay or cast iron pipes. In larger diameters, the pipe ends are placed on saddles and the joints covered with a wire netting of about 1 in. mesh upon which cement mortar is smeared with a trowel to a thickness of 1 in. or more and the width of about 5 ins. Saddles and wire nettings are delivered with the pipes from the factory. In the construction of sewers in Offenbach, Germany, about 3,000 ft. of 5-ft. sewers were laid on the continuous system in 1884, and in 1892 25,000 ft. were laid by the more modern system of building the pipe at the factory and laying them on saddles as just described.

The carrying rods in pipes are, of course, around the circumference while the distributing rods run longitudinally. Pipes subjected to internal pressure have the carrying rods near the exterior surface, while in pipes with external pressure the rods are locaied nearer the inner surface. Regarding the strength of Monier pipes it has been proved that while they weigh less than common vitrified clay sewer pipe, they have about six times the strength of the same. In the construction of large reservoirs for water, the carrying rods are located horizontally and the distributing rods vertically. If the reservoirs are not exposed to shocks or heavy vibrations, it is customary to place the distributing rods at a distance from four to six times the space between the carrying rods. The thickness of the walls is reduced to remarkably small figures. Large reservoirs are built of a thickness from 2 to 3 ins. at the top and 4 to 5 ins. at the bottom. A reservoir at Leipzig water works contains about 2,000,000 gals. In France there are over 1,000 water reservoirs built of Monier construction.

It will readily be seen that Monier construction may be applied to good advantage as flumes and tail races in turbine construction as, for instance, in a large factory of arms at Steyr, in Austria, where there are two large Monier turbine constructions with 1,500 ft. of flumes and tail races. One of the most permanent constructions in fortified concrete is the new intercepting sewer system in Paris, France, which was described and illustrated in the October and November issues of the Cement and Engineering News of 1899.

To show how universal the construction of Monier pipes and sewers is in Germany, I add a list of some of the pipe contracts executed by G. A. Wayss of Berlin.

Offenbach a. Main, about 10,000 lin. ft. of circular Monier pipes for sewers from 12 ins. to 22 ins. in diameter elliptical pipes from 20 ins. x 30 to 40 ins. x 60 ins. in the clear.

Koenigsberg, elliptic sewers 20 in. x 32 ins. to 40 ins. x 75 ins., about 3,300 ft.

Kaiserslautern, 3,300 ft. of sewer pipe of different dimensions.

Breslau, 3,300 ft. of 32 in. sewer pipe.

Muelhausen, 3,300 ft. of 32 ft. of elliptic sewer pipe 24 ins. x 35 ins.

Bremen, 5,000 ft. of sewer pipe 35 ins. x 52 ins.

Flensberg, 3,300 ft. of sewer pipe.

Venezuela, South America, 33,000 ft. of Monier pipe, circular and elliptic, for railway construction.

And besides Monier pipes of all descriptions in the following towns:

Ederswalde	Spandau	Falkenberg
Altona	Potsdam	Pr. Eulau
Perleberg	Berlin	Grottkau
Luneburg	Bromberg	Neustadt O. Schl.
Frankfurt, a. d. Oder	Coln a. Rh.	Oehls
Magdeburg	Sommerfeld	Rixdorf-Berlin
Kottbus	Sprau	Diedesfeld
Breslau	Liegnitz	Zuethen
Inowrazlaw	Newmarkt	Oppeln i. Schl.
Brieg	Clausford	Posen
Strehlen	Kneiting i. Bayern	Tarnowitz
Waldenbyrg	Strassburg i. Els.	Sagan
Glatz	Gassen	Ostrowo
Karlshruhe	Neumarkt i. Bayern	Osterode am Harz
Altenstrig i. Bayern	Ludwigshafen	Zweibrucken
Budapest	Munchen	Andreasberg a. Harz
Traunstein	Briesen	Steyr
Napoleonsinsel	Wilhelmshaven	Bernburg i. Anhalt
Strassburg i. Els.	Frankenthal	Wismar i. Mecklbg

Greifshagen	Waldhoff
Neckarau bei Mannheim	Gr. Lichterfelde bei Berlin
Achonebeck a. d. Elbe	Andendung gekomnen
Haselhorst bei Spandau	Furstenwalde a. d. Spree
Freienwalde a. d. Oder	Ludwigshafen a Rhein.

Below follows a list of water basins, reservoirs, filters and tail races, executed in Monier construction:

Charlottenburg Water Works, a double reservoir of 70,000 cu. ft. contents.

Leipzig, a water stand pipe of 300,000 ft. contents, built in 1885.

Stralsund, a filter chamber of 52,000 sq. ft. surface one-half being open, the other one-half covered with Monier arches from 21 to 26 ft. span, all being surmounted by a double reservoir of 100,000 cu. ft. contents, supported on Monier arches of 33 ft. span, built in 1892.

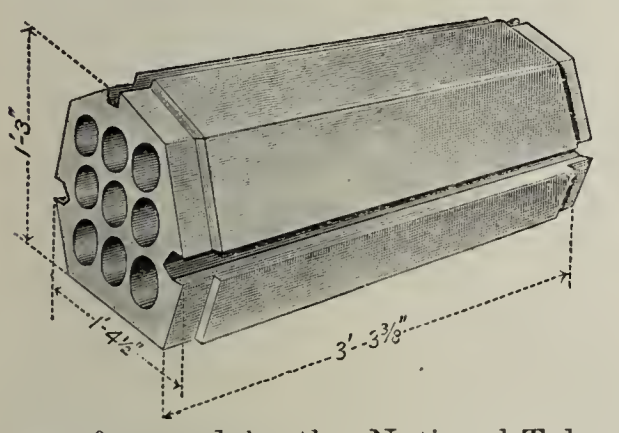
Haselhorst bei. Spandau, gasometer reservoir in Monier construction 24 ft. in diameter and 13 ft. high.

Harburg tar cistern 26,000 cu. ft. contents, resting on Monier arches of 15 ft. span.

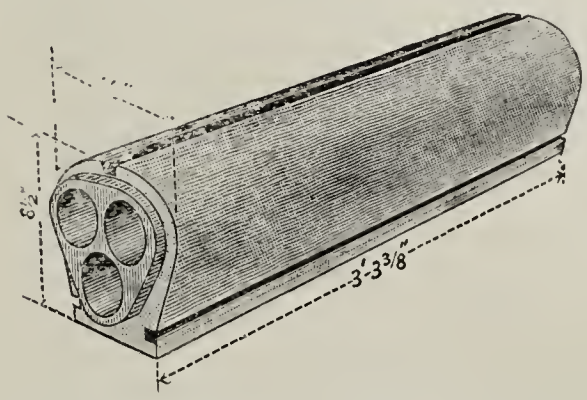
Charlottenburg reservoir tower, with four large reservoirs in Monier constructions of 23 ft. in diameter and 10 ft. high.

CONCRETE CONDUITS.

We illustrate a new form of English concrete section conduits for underground electric mains used and



manufactured by the National Telephone Co., Ltd., 58 London Wall, E. C., England. These sections are made to carry 3, 6, 9, 12, 16, 20, 24 and 30 cables and are 3 ft. 3⅜ ins. long. Experience has demonstrated that Portland cement concrete has no injurious effect on lead covered cables and that these conduits mature and



improve with age. They are entirely free from the defects incident to the manufacture of burned clay conduits which usually become warped and distorted in the process of burning. The manufacturers of these concrete conduits maintain fifteen different distributing offices in as many cities of England, Ireland, Scotland and Wales for the sale of the same.

A RECEIVER APPOINTED.

W. J. Johnson of Fort Smith has been appointed receiver by Federal Judge Rogers for the White Cliffs Portland Cement and Chalk Company of White Cliffs, Howard county, Ark. There has been a recent reorganization of the company, after which a lease of the property was made to the Arkansas Cement Company for a rental of $20,000 a year, which petitioners allege to be less than the interest on the money invested.

PROPOSED CANAL ROUTES ACROSS THE AMERICAN ISTHMUS.

By Thomas Wright Hurst.

Congress has granted to President McKinley $1,000,000 to defray the expense of survey and examination of the various proposed routes for a ship canal across the American Isthmus, by competent engineers. I will briefly describe a number of these proposed routes or lines, basing what I have to say upon published papers, reports, etc.

NICARAGUA.

This line starts from Brito, on the Pacific, follows the Rio Grande and Lajas rivers to Lake Nicaragua, a distance of 17½ miles. Some dredging would have to be done through the lake from the mouth of the Lajas to Fort San Carlos on the Eastern shores, being 56½ miles. From that point the River San Juan is followed for 69 miles. Two important tributaries enter the San Juan, the San Carlos and the San Francisco, at a point called Ochoa, from that place a regular canal would be constructed to Greytown on the Atlantic side. The distance from Greytown to Brito is estimated at about 169 miles. Col. Childs in 1851 surveyed this line for Cornelius Vanderbilt and gave the length as over 194 miles. Lake Nicaragua is 95 miles long, 30 miles wide, average depth 15 fathoms. Elevation of lake surface above mean level of ocean 125 feet. Frederick Boyle, F. R. G. S., in his work "A Ride Across A Continent," says, "I never saw sea or ocean that could compare with it in violence or treachery." The San Juan river is 120 miles long, 2 to 20 feet deep. Navigation is impeded by five rapids, still small steamers have ascended its entire course.

The heat on the banks of this river is excessive, increased by the high woods, the trees being so thick as to intercept the sun's rays, the earth being covered with rotten leaves and putrid vegetation. It has many noisome marshes on its sides. A British expedition in 1780, numbering about 1800 people, were sent to different ports to form dependencies. Few of the Europeans retained their health above 16 days, not more than 380 ever returned to Europe, mostly in a miserable condition, many afterwards becoming imbecile or insane.

The country is also subject to earthquakes and volcanoes. Humboldt says, "there is no spot on the globe as full of volcanoes as this part of America, from the 11th to the 13th degrees of latitude."

Commander Selfridge, U. S. N., in his report says, "this line is utterly destitute of harbors." This in connection with the bad climate on the Atlantic side, the violent storms on Lake Nicaragua, the great distance from Greytown to Brito, the danger from volcanoes and earthquakes renthis line very undesirable.

The Nicaragua route via Lake Managua would increase the length nearly 100 miles. The Nicarzgua line connecting with the Gulf of Forneca or Conchalagua is also undesirable on account of the great length, etc. Another plan is to cut to the Gulf of Nicoya. Another line from the mouth of the Sapoa river at the southwest part of Lake Nicaragua to Salinas bay was surveyed in 1858 by M. Thome Samond and pronounced impracticable. This latter line would be altogether in Costa Rica. (Dr. Ed. Cullen in Society of Engineers, London, Eng., transactions, 1868.

THE FRENCH PANAMA SHIP CANAL.

This unfortunate ship canal, promoted by M. de Lesseps, extends between Limon and Aspinwall on the Atlantic side to Panama on the Pacific side in the main parallel to the railway and some distance south of the Nicaragua canal. A liquidator was named by the court of the Seine, Paris. In 1890 a commission of French and other engineers sent to to the isthmus by him gave a very discouraging report. Lesseps planned for a sea level canal. It is now proposed to construct one with locks. "The ship is to go 7½ miles on the sea level to Miraflores, where she will be lifted by one lock, 23 feet, more or less, depending on the state of the tide, then she will go 1¾ miles to Pedro Miguel, where two locks are to lift the ship 55½ feet to a new level 80 or 90 feet above the sea. The ship moves 1¾ miles to Paradiso, where two locks are to lift her 55 feet more to the highest level of both oceans, thence over this high level she proceeds to Obispo, 6¼ miles, where it begins to descend toward the Atlantic. At Obispo three locks lower her 65½ feet at which point she will reach the artificial lake, area 21 sq. miles, to be made by draining the Chagres river, then through this lake 13 miles to Buhio, where two locks will lower the ship 65½ feet to the sea level canal, extending 15 miles to Colon and the Atlantic."

The harbors are insufficient "that of Aspinwall is so shallow that ships during the season of the 'northers' are obliged to put to sea. At Panama there is not water at low tide to float large vessels within 2½ miles of the town; a channel under water would have to be cut in the rock." (Commander Selfridge, U. S. N. Report, page 71.)

The terrible Chagres river crosses this canal line 78 times and the Rio Grande 13 times and frequently rises 50 feet in 24 hours.

President Hutin claims that the Culebra Pass is perfectly easy of execution and solves every problem in connection with the Panama route. A commission of French engineers, sent over by the French government after the failure of the old company, made a most voluminous report, without conceding that route as feasible. They say that if certain possible contingencies did not happen the canal might be constructed for something like $1,000,000,000; this, Mr. Hutin has whittled down to $100,000,000.

The Isthmus and its towns are hot beds of malignant disease. The great and apparently insurmountable obstacles to a tide level canal are the marshes and quicksands of the Atlantic Coast. The unruly Chagres periodically overflows and fills the valley of the isthmus. In 1879 a flood, lasting four days, swept all before it and covered the railway with 12 feet of water. There are serious natural obstacles on the line of the canal, such as the swamps and volcanic ledges on the Panama side, earthquakes occur also. In September 1882 much damage was done to both isthmian cities and the Panama railway by a severe earthquake, while a tidal wave swept the islands and coast on the Gulf of Darien, on the Atlantic side, causing great destruction of life and property. To natural obstacles must be added the great cost of labor and living. The long, wet season of nearly eight months causes delays and damages to cuttings.

SAN BLAS OR CHEPO LINE.

This route is the shortest across the isthmus. It runs from Sans Blas or Mandanga bay, on the Atlantic side to River Chepo or Bazamo, flowing into the Pacific. Mr. F. Kelley of New York surveyed the route from San Blas to Chepo in 1864. He found San Blas harbor spacious and deep, while the channel of the Chepo had not less than 18 feet of water at mean low tide. A canal in this direction would require a tunnel about seven miles long.

"The total distance from the Atlantic to ship navigation on the Bazamo river is 27 miles, the width of the isthmus at San Blas from ocean to ocean is 37 miles. Though, as demonstrated, this route is neither practicable from the length of the tunneling nor for a system of lockage, there being no streams to carry it over the summit level of 1,100 feet. It is a question whether a canal, combining the two principles of lockage

and tunneling, could not be constructed from the shortness of this line, at a less expense than upon other routes over which, in this respect, it has such a great advantage. (Report Commander Thos. Oliver Selfridge, U. S. N., 1874.)

Commander E. P. Lull, U. S. N. says, regarding this line, "the Bazano river on the Pacific side cannot be utilized and an independent canal would have to be built from the end of this tunnel to the sea. The line possesses but two features, one the magnificent harbor afforded by the Gulf of San Blas, the other the short distance from sea to sea, in a direct line of but 30 miles. These, however, compensate but slightly for the enormons disadvantages. The bar, which is said to be a shifting one, lay 12 feet below the surface at the time of our visit, near the island of Chapello and about 2 miles from the mouth of the river proper. The cost of a tunnel of suitable cross sections with masonry arch, and of one mile in length, Mr. Menocal computes to be not less than $15,000,000, while for greater length the cost would be increased in a very rapid rapid ratio." (Senate Documents, 1878-1879, surveys for the location of the ship canal, Isthmus of Panama.

KARWEISE ROUTE.

This line, proposed by Mr. Gustavus A. Karweise, C. E., a description of which appeared in *Engineering News* (New York) of March 14, 1895. This is said to have 11 miles of free navigation up the Bay of San Miguel and Tuyra river, but he proposed a tunnel 11,880 feet long. The total distance from ocean to ocean would be about 93½ miles. The summit of the range at the sight of the tunnel is 1,180 feet above the sea level. As to harbors, the Gulf of San Miguel promises an excellent harbor on the Pacific side, but it is not so clear as to the harbor on the Atlantic side.

THE TEHUANTEPEC LINE.

"The width of the isthmus from the mouth of the River Coatzacoalcos to Tehuantepec on the Pacific is about 138 miles in a straight line. The entire distance of the canal line would be 210 miles, and the enormous number of 150 locks would be required. The adjacent coasts are frequently troubled with furious storms. There is no harbor of any kind on either coast."

THE HONDURAS LINE.

"This route has good harbors. It was proposed to begin at Puerto Caballos (Port Cortes) in the Bay of Honduras to Fonseca bay on the Pacific. The construction of a canal is utterly impracticable since the summit level to be attained is 2,956 feet above the level of the sea, and there would not be enough water to supply a canal. The length of the proposed railroad over this line was 241 miles."

THE CHIRIQUI ROUTE

This would lead from Chiriqui lagóon on the Atlantic to Golfo Dolce on the Pacific. The former is an excellent harbor. Of Golfo Dolce, Commander Jeffers, U. S. N., says: "It is unsurpassed in natural facilities." However, considering that immediately inland of the lagoon the Cordillera presents the summits of Cerro Robalo, 7,012 feet high, the volcano of Chiriqui 7,001 and another 7,452 feet high, it is not probable that any pass exists sufficiently low for a canal.

THE ATRATO LINES.

The following extract from a letter of Lieut. Augustus Craven, U. S. N., to Dr. Cullen, gives the results of the former's survey of this line.

BOUND BROOK, N. J., Aug. 3, 1858.

DEAR SIR:—I received your communication of January while on my return from the Atrato. I arrived in the United States early in May, having made a thorough examination of the route by the Atrato, Truando, Nerqua and Totumia rivers. The entire distance across is 134 miles, which I twice traversed with the parties under my command. My preliminary report was made to the United States senate on the 17th day of May and has appeared in our papers generally. I suppose, therefore, you have seen it. I do not say that the construction of the canal is an impossibility, but its cost will be immensely beyond the views of this age. My detailed report is not made out, but I believe my estimates will reach some $500,000,000, with 50 years of labor.

THE ATRATO NAPIPI AND CUPICA LINE.

The entire length of this line from sea to sea would be about 241 miles. From the examination made by Don Juan de Dios Ulloa, a Granadian engineer, and the surveys afterwards made by Mr. Trautwine and Dr. Halsted, and then by Messrs. Viennish, Nelson, Rude and Dr. Jameson it appears that the dividing ridge is of such an elevation (about 500 feet) and breadth that a tunnel about 6½ miles in length would be necessary. Cupica bay, moreover, is small and only an open roadsted. The obstacles presented by the bars and sandbanks at the mouth of the Atrato are most formidable. Mr. Trautwine estimated the cost of a canal by this line at $325,000,000.

THE ATRATO AND SAN JUAN LINE.

This is the most Southern and longest line between the Atrato and the Pacific. The distance from the Coquito mouth of the Atrato to Santa Monica is 281 miles, thence to San Pablo, 3¼ miles and from San Pablo to Chiramdira, at the mouth of the San Juan, 123 miles. The total distance then would be 407¼ miles. The elevation of the ridge above the level of the sea was not ascertained but it must be very considerable. Mr. J. C. Trautwine, C. E., (in his book entitled "Inter Oceanic Canal Route," Philadelphia, 1854) reported that a canal by that line would be impracticable. It was afterwards surveyed by Mr. Porter and Mr. Lane, who gave the same opinion, and was also examined by Mr. Vincent of Southwark with the same result.

THE ATRATO PATO AND BRANDO LINE.

At the distance of 237 miles above its mouth the Atrato receives the Pato, the head of which is 30 miles above the confluence. From its head a pass of 1¾ miles, with a summit level of 365 feet above the oecan, leads to the Bando, which, after a course of 80 miles, falls into the Pacific between Cape Corrientes and the mouth of the San Juan. Its length 348¾ miles is less than that of the San Juan route, but Mr. Lane, Mr. Porter and Mr. Trautwine, each of whom surveyed it separately, found that it had no superiority over that line. (Dr. Cullen in Society of Engineers. London, Eng., Transactions, 1868)

THE MORTI LINE.

"This line, starting from Sassardi harbor, on the Atlantic side, follows the direction of the river of the same name, then across the divide to the Morti, then adown that river and westward in a direct line to the Savana river and down the latter to the Pacific. The true divide proved to be 1,148 feet in height and the Morti where the level line met it, 289 feet. Though all our research failed to find any indications of a pass, the height of the Morti would preclude one under 300 feet. A system of lockage is not applicable to this route, there being no streams affording an adequate supply of water. As to tunneling, taking the altitude of the junction of the Chucunqua and Morti as previously deducted at 160 feet, the distance from this point to a similar altitude is 9 miles. From these facts it is evident that this route is equally impracticable of canalization with the Darien.

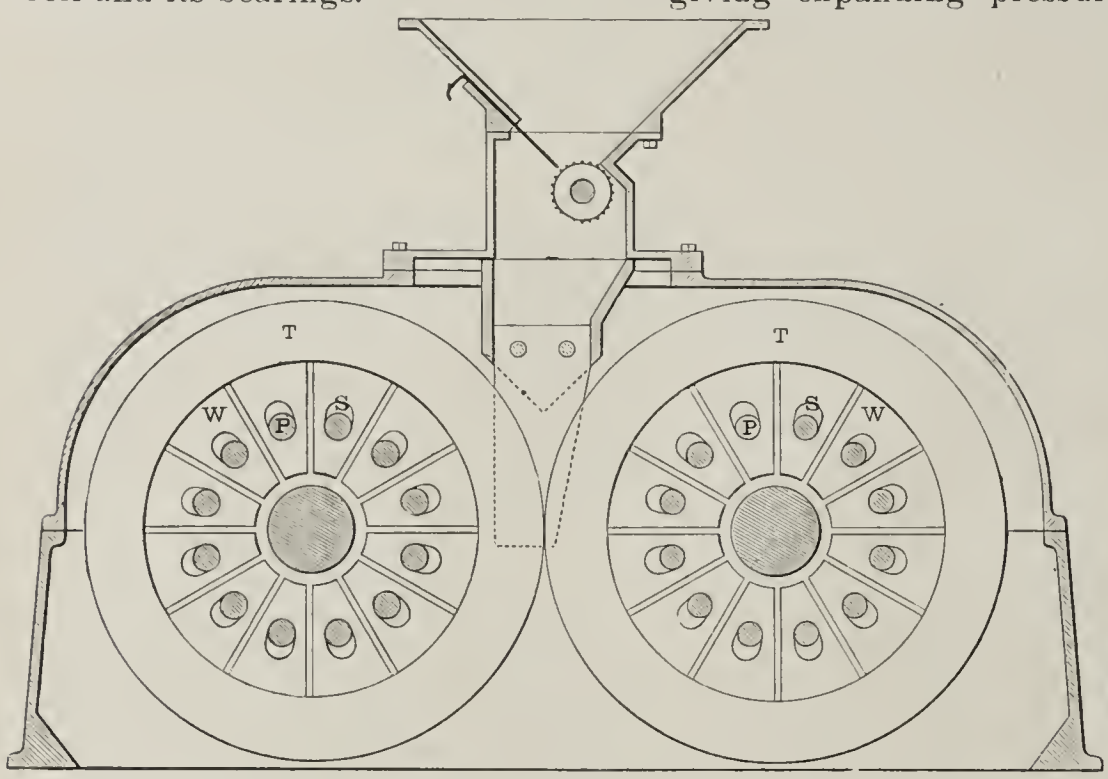
[TO BE CONTINUED.]

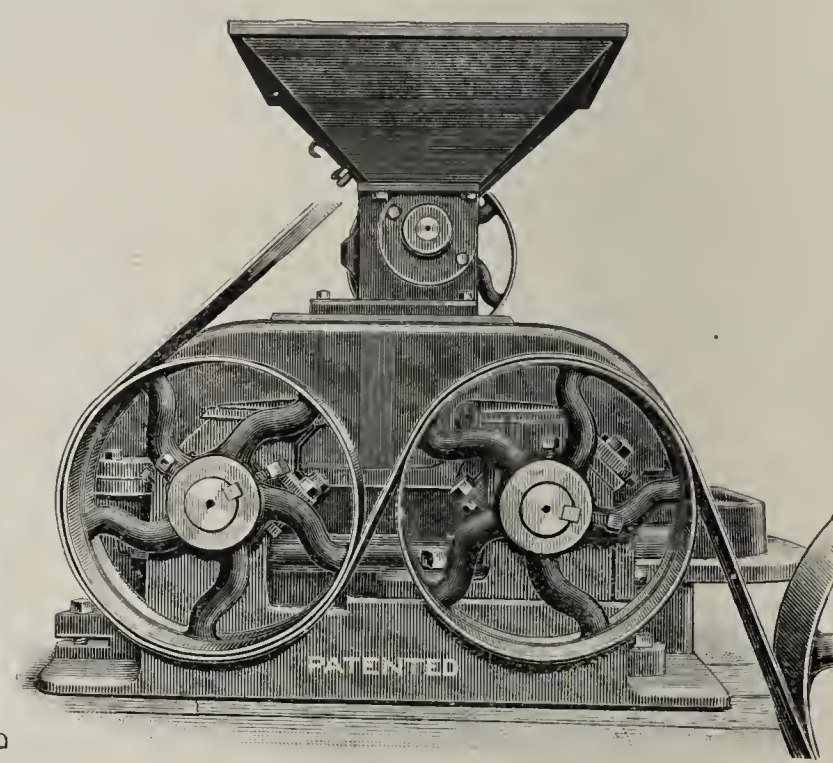
The business mens' association of Holly, Mich., are securing options in the vicinity on marl lands with the view of starting a Portland cement plant.

The Osborn Co., engineers, Osborn building, Cleveland, O., are preparing plans and specifications for the additions to the Marquette Cement Co.'s plant at Deer Park Glens, Ill.

CENTRIFUGAL ROLLS.

Centrifugal rolls are so named because they alone crush by utilizing the immense centrifugal forces generated by their rotations. No springs are needed to force the roll faces together, and, although the space between the tire faces opens and closes as in common rolls, yet, in centrifugal rolls neither shaft, or roll, or bearing has any backward or forward movement. For these reasons no crushing push can be transmitted to the roll shafts. These entirely escape the direct shocks and the pounding caused by the backward and forward movements of the heavy common roll and its bearings.





Centrifugal rolls have also the singular property of automatically balancing themselves and run with nearly the steadiness of dynamos. Since the output of common rolls is directly as their peripheral velocities, centrifugal rolls, which easily run three times as fast as other rolls of equal size, should have three times their capacity and their output is said to exceed this estimate.

The following description and cuts describe their construction and operation:

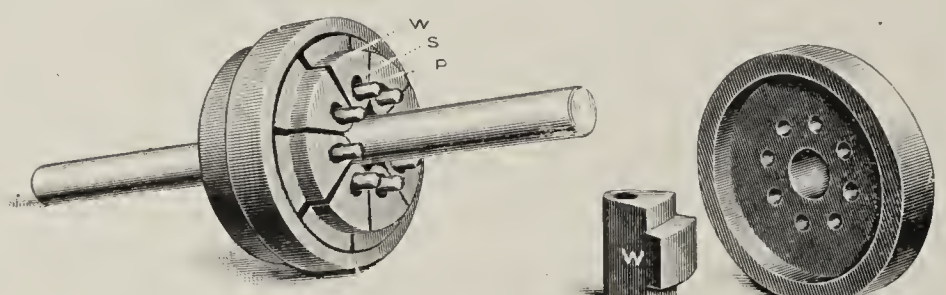
The centrifugal roll consists of but three important parts, viz., the shaft, the segment weights (W) and the tire. The segment weights together, in operation, form a roll, over which is placed the tire. Each weight is held to the shaft flanges by the pin (P) passing through the weight slot (S.) Each weight rotating with the shaft is set out by centrifugal force, and together the weights form, as before stated, a strong roll. The segment weights are prevented from giving expanding pressures to the tire by strong steel hub flanges.

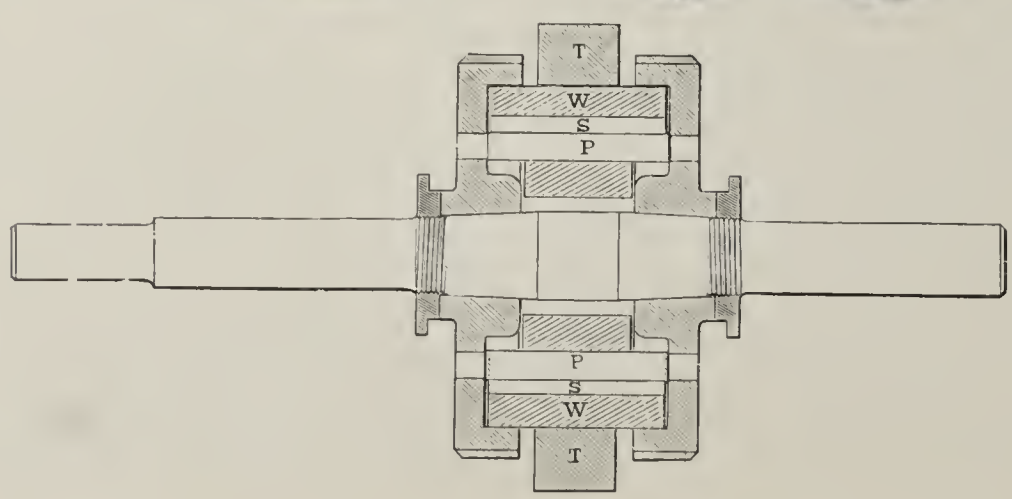
The slots S permit each weight to move back on its pin toward the shaft, but its backward movement can transmit no push to the shaft.

It is plain that the weights (W) in running hold the tire in position by the immense power of centrifugal force.

The tires in a pair of rolls can only be pushed back towards their shafts qy a superior force and as no rock is strong enough to exert such force it is easily crushed. Should a particle of uncrushable steel enter between the rolls and force back the tires and weights no harm can be done, as no crushing shocks are transmitted to either shaft. The roll shafts are not pressed back at all.

This action may be illustrated by a weight rotated from a shaft by a cord. The weight may easily be pushed back, but no push can be transmitted to the shaft. It is thus seen that if centrifugal roll faces are set as closely together as wanted no springs are needed to keep them in position.





Centrifugal rolls, balancing themselves run easily at all speeds. Very moperate speeds give to large centrifugal rolls ample crushing power.

Centrifugal rolls of even moderate size do more and better work than the largest common rolls. They run easily, as shown in the cut, with small driving pulleys and require so much less power than slow-running common rolls that no balance wheels are needed. It is to be noted that centrifugal rolls of very moderate dimensions do excellent work and cost less to buy, to transport, to set up, to run and cost less for repair parts, which are all comparatively small.

The Helderberg Cement Co. is making extensive improvements and will install ten new rotary kilns. It now has two in operation.

Incorporated: J. E. Murphy, R. P. Butchart, G. S. Kilbourne, John Lucas, J. M. Kilbourne and D. M. Butchart of Owen Sound have been incorporated as the Shallow Lake Portland Cement Co., of Ontario, Limited, with a share capital of $200,000 less one dollar.

ALMA PORTLAND CEMENT CO.

The plant of the Alma Portland Cement Company at Wellston, Jackson county, Ohio, has now been in operation about eleven months and has demonstrated the feasibility of manufacturing the highest grade of Portland cement from limestone and clay by the rotary process. The plant was designed by Messrs. Lathbury and Spackman, engineers, of Philadelphia, and is located west of the crossing of the C. H. V. & T. Railroad and the Ohio Southern. Along side of the Ohio Southern are located both the C. H. & D. Railroad and the B. & O. S. W. Railroad, thus giving the plant unusual shipping facilities and competitive rates from four railroads which have sidetracks into the works. The main building, constructed of brick, with frame roof 380 ft. x 125 ft., was formerly used as a nail mill and on the erection of the cement plant this building was reconstructed and divided into three parts, one for the raw material, another for the burning and grinding of the clinker and the third utilized as a stockhouse for the finished cement. The other buildings were afterwards erected as follows: Power house, 75 x 100; clay storage, 100 x 60; limestone storage house, 100 x 50, together with the coal grinding building, machine shop and chemical laboratory.

The limestone is conveyed to the mill from the quarries which are located about four miles distant while the clay beds are located on the company's property, adjacent to and surrounding the mill. Both the limestone and clay are of the highest quality for the manufacture of Portland cement. The extent of the deposits of both limestont and clay are ample for the ultimate capacity of the plant which will be 900 bbls. per day.

The power plant consists of three tubular boilers of 200 H. P. each and two engines of 350 H. P. and 250 H. P. These engines are belted to two 250 K. W. Eddy generators. The various machines throughout the plant are driven by Eddy and Westinghouse motors operated by main circuits run from the generators in the power house on a 220 volt direct circuit. The motors are distributed in the different departments and drive to either single machines or to groups of two or more machines of the same class.

Up until the time of the construction of this plant in 1898-99 the exclusive use of electric motors for driving all machinery had been favorably discussed by cement manufacturers and designing engineers, but the concensus of opinion seemed to be that the excessive dust arising in all departments of the manufacture would prove detrimental to the motors. Discouraging opinions were offered as to the efficiency and economy of the direct current system operating under such conditions by both the Westinghouse and General Electric Companies. The alternating current system was offered as the one most favorable and which would not possess the disadvantage of having the commutators cut out by the sharp cement dust. The principal owners of the plant, however, being coal mine operators and having successfully utilized the direct current system with motors in their mines, authorized the engineers to adopt this system and proceed on these lines. The recommendations of the engineers on housing each motor in dust-proof portable casings were carried eut in the first installation of the plant, but after operating successfully for two months the housings around each motor were found unnecessary and removed as the dust itself appeared to have the effect of polishing the commutators, and on starting up the motors the high speed of the shaft was found to act as a fan in expelling the dust from around the coils of the machines.

The installation, which was experimental from its inception, became a positive success from the start and much valuable data has been secured in efficiency and economy over the use of shafting for the transmission of power under conditions existing in a Portland cement plant.

The raw materials, limestone and clay, are treated separately but in nearly the same manner. The limestone is first crushed down to one-inch size, thoroughly dried and then reduced in a disintegrating machine before being finally ground in tubemills. The large lumps of clay are first broken up, passed through a rotary dryer and then reduced in a disintegrator preparatory to being ground together with a proper proportion of limestone in tubemills. This final grinding together of the two ingredients not only reduces them to an impalpable powder but thoroughly and intimately combines the limestone and clay and produces what is known as the raw mix. This dry material is then conveyed to steel bins and afterwards fed into rotary kilns where it is burned with pulverized coal forced in under pressure. The clinker is cooled, and after being automatically handled is first reduced by a disintegrator and then finally, by the use of tubemills, ground up into cement and afterwards conveyed into the bins located

ALMA PORTLAND CEMENT MILL LOOKING EAST TOWARD POWER HOUSE.

in the stock house, which has at present a capacity of over 30,000 bbls. of finished cement.

The machinery installed is of the latest and most improved type and the plant was designed to make the system of manufacture as nearly automatic as possible. The main building will accommodate six rotary kilns and, although but two kilns were installed at first, two more with further grinding machinery is to be added this coming spring.

The power plant, coal grinding building and part of the grinding machinery for raw and finished material was installed for the ultimate capacity of the mill. The plant has several features and advantages, both distinctive and unique, in that it is the only mill having the advantage of four separate and competing railroads which run directly into the works and offer shipping facilities to all large cities as centers of distribution for Portland cement. It is also located nearer than any plant to a coal mine from which it obtains its fuel both for kilns and boilers. The coal is obtained not over one-half mile from the plant and in fact the mill proper is located directly over abandoned mine passage ways about one hundred feet below the surface of the ground. It is the first plant constructed for the manufacture of Portland cement by burning the dry raw materials, limestone and clay, in rotary kilns and thereby demonstrating the feasibility as well as economy of such system of manufacture. Finally, it is the first plant entirely operated by electricity. It is thus seen the plant has decided advantages not possessed by other plants, and, coupled with this, the cement produced is equal in quality to the highest grade of either foreign or American manufacture. We understand it has been used during the past season in several large pieces of work in the middle states for both foundations and pavements with equally good results The average tensile strength, neat, in 24 hours is 275 lbs., while in 7 days it develops a strength of 750 lbs. neat, and 285 lbs. 3 parts sand to 1 part cement. At 28 days the neat test shows results of 970 lbs. and sand test of 330 lbs. The cement is finely ground, slow setting, and meets all requirements covered in the hot and cold water tests.

A POSITION OF RESPONSIBILITY

is solicited by mechanical engineer, experienced in crushing, cement grinding and screening machinery, belt conveyor engineering, steam plant and heavy mill engineering.

Address "C. S. E.," care of the *Cement and Engineering News*, **161 La Salle Street, Chicago, Ill.**

EXTRAVAGANT WATER TUNNEL CONSTRUCTION.

The city of Chicago has about completed thirteen miles of land tunnel to be used for water service. The firm of Weir & McKechney & Co., contractors for section 3 of this work, pursued an extravagant system in carrying out their contract, whereby they secured a judgment against the city of $540,000 for extra work, upon the testimony of expert engineers, in excavating the back filling under the cap and battier system, whereby great quantities of earth and rock were blasted out above the roof line

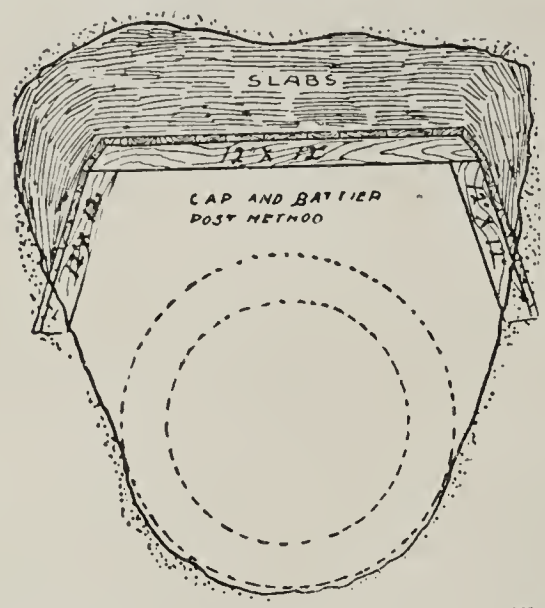


Fig 1. The cap and battier method pursued by Weir & McKechney.

line of the bore. The internal diameter of the tunnel is only 8 ft., while the entire excavation in some instances reached 30 ft. above the top of the tunnel.

Fig. 1 shows the Weir & McKechney methods and Figs. 2 and 3 the method pursued by the city after July 7, 1899, at which time the city declared the contract with Weir and McKechney forfeited. The work was then placed in charge of Paul G. Brown, assistant city engineer, who carried on the work by day labor, with the following results:

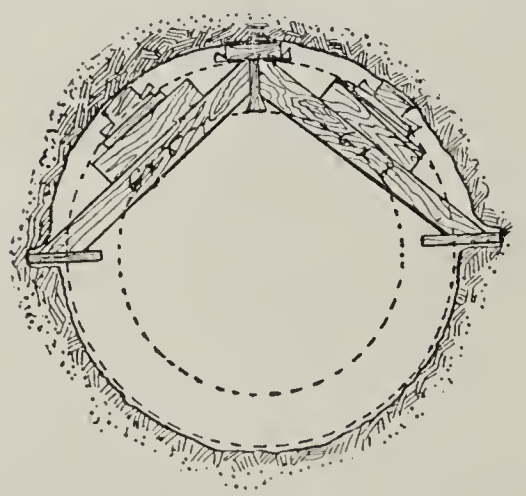


Fig. 2. The crutch method adopted by the city.

The cost to the city in excavating clay headings averaged $24.41 per ft. Weir & McKechney were paid $68.45 for the same class of work, and for which the original contract price was $24 65 per ft.. The city did the rock excavation for $38.00 per ft., while the contractors received $91.19 for the same class of work. The original estimate for section 3, for a tunnel 22,117 ft. long, 8 ft. internal diameter, was $400,000. The city granted the contractors $360,000 for extras, while the city has paid $150,000 for day labor for completing 400 ft. of rock and 1,600 ft. of earth, making the entire cost $1,450,000, or $1,005,000 over the original estimate.

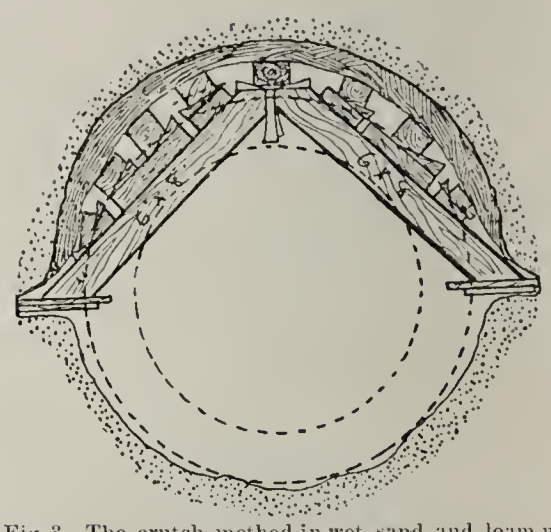


Fig. 3. The crutch method in wet sand and loam used by the city.

The economical methods pursued by the city of Chicago in finishing the last section of this tunnel completely overturns the value of the expert testimony upon which Weir & McKechney & Co.'s judgment is founded, since the system pursued by the city was upon lines which expert engineers from various parts of the country declared to be impracticable.

CANVAS BAG FOR DEPOSITING CONCRETE UNDER WATER.

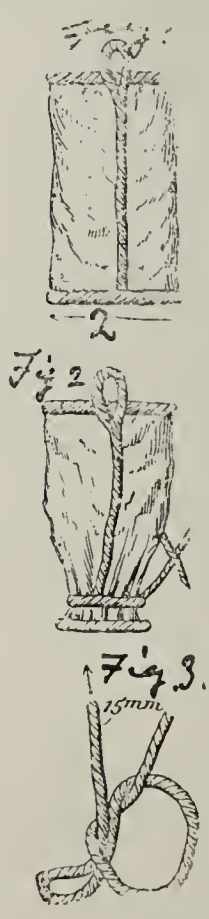


Fig 1 shows a bag open at both ends. Fig. 2 shows the lower end of the bag tied together by a rope (Fig. 3) with a slip noose, the pulling of one end of the rope tightens the noose the other slips the loop and permits the concrete to escape from the bag by hoisting the lowering cable attached to the upper end of the bag.

The Portland Cement Co. of Milton, N. D., is preparing a night shift to bring the output up to 150 barrels per day. It is now working on an order for 10,500 barrels.

EUROPEAN CEMENT TRADE REPORT FOR 1899.

JANUARY, 1900.

The year just closed has been a record one in the cement trade. In all large producing countries—viz., the United Kingdom, Germany, Belgium, France, and last, but not least, the United States supply has barely kept pace with demand.

Great Britain—The English mills, favored with uninterrupted home consumption during the winter months and supported by a fair export demand, commenced the spring with small stocks. Advanced prices were paid for home and export consumption during the spring and early summer months, values attaining their highest during June and July.

During the early autumn a slight falling off in home consumption, resuiting in accumulation of stocks by some of the smaller mills, caused selling values to weaken, but subsequent demand proving above normal, prices have since recovered, but closing below top rates paid.

Whilst the trade has had a prosperous year, the margin of profit has been reduced, owing to the increased expense of production, caused by higher cost of fuel and labor.

The outlook for the year on which we have just entered is bright. Stocks are not heavy and the building trade continues healthy. Large public works in this country and abroad will probably absorb considerable quantities of cement during the next twelve months.

Exports are as follows: January to December, 1898, 325,674 tons; January to December, 1899, 353,615 tons.

Whilst exports to the United States, as compared with 1898, shows a reduction of 10,000 tons, the consumption in other markets has been well sustained, notably in South Africa, South America and Canada.

We quote current prices as follows: First-class brands, 6s. 3d. to 6s. 9d. per bbl., f.o.b., export Str. Good merchantable brands, 6s. to 6s. 3d.

Whilst, undoubtedly, the tendency in prosperous times is to increase production we are of the opinion that the English mills during the present year have attained their maximum out-turn for the present, although in an article such as cement an increase is more quickly effected than in many other staple manufactures.

One feature worthy of record in the United Kingdom trade is the increasing consumption of foreign cements in this country. Whilst accurate returns are difficult, we estimate imports into the United Kingdom for 1899 to be not less than 120,000 tons. The bulk has consisted of Belgian Natural Cements, which, when of reliable manufacture, can be safely employed on all ordinary building work.

Germany—Favored with a continued large inland consumption and fair export orders, the mills have averaged rather higher prices than in 1898. Stocks throughout Germany are not heavy, and already a fair percentage of the present year's production is disposed of. Many of the larger works have increased their plant, and new works are also starting during the present year. To maintain present prices a large consumption will therefore be necessary, failing which there is a probability of some concession in price on the part of the mills. Taking the trade as a whole, there is more disposition to meet consumers on individual orders, but for contracts ahead the mills have not so far made any material reduction off last year's prices.

We quote current values as follows: First-class brand, Ms. 6·50 to Ms. 6·70 per barrel, f.o.b. export steamer. Good merchantable brands, Ms. 6·25 to Ms. 6·50 per barrel, f.o.b. export steamer.

Whilst final returns for 1899 are not at hand, for the ten months ending November, the total exports to all foreign countries amounted to 505,318 tons, as against 464,742 tons January to November, 1898. Shipments for the United States showed an increase over 1898 of nearly 30,000 tons, whilst exports to South America were also larger. For Canada, demand was not heavy, all told amounting to about 8,000 tons. Exports to China exceeded 25,000 tons, as against upwards of 10,000 tons for 1898—an increase accounted for by railway construction—German cements having the preference.

Belgium—Throughout the year the mills have enjoyed a good trade, inland consumption being fairly large. The Artificial Cement Works claim to have made a record year, not only as regards the turnover, but also in price. The Natural Cement Mills also have been favored with an exceptionally active demand both for home and export consumption. Neighboring continental countries have been buying the Belgian production more freely, and the best grades are now finding a regular market in the United Kingdom—a trade which is likely to prove a permanent one.

Turning to exports, we find that the total shipments to the United States of America (which were upwards of 102,000 tons) were slightly under 1898, whilst the Argentine, Brazil, Australia and the East Indies showed an improved off-take as compared with previous years.

Undoubtedly, in certain markets the higher prices demanded by the mills have checked consumption, and in the United States the large increase in the Rock Portland Cements has given a slight check to demand, but on the whole the Belgian trade has made further progress during the year both in the total producsion and prices paid.

The visible demand ahead warrants a continued maintenance of prices, but the keen competition that exists in this trade, coupled with the fact that much of the cement manufactured appeals only to trade for price, may have later on an adverse effect on values, but for the present any decline in value appears to be checked owing to the very high cost and scarcity of fuel.

In conclusion, the cement trade starts the year well from a statistical point of view, and we believe that the present estimated production for 1900 will not more than suffice for the trade in view. At the same time periods of prosperity like the present tend to over-production, and in time, undoubtedly, supply will overlap demand.

TULLOCH & Co., Exporters,
4 Fenchurch Ave., London, E.C., Eng.

FIRE BRICK CATALOG.

The Garden City Sand Co. of Chicago has issued a comprehensive 32-page catalog on fire brick and fire clay, full of useful data, with an analysis of the ten leading American fire clays. Diagrams of shapes and rules for figuring fire brick linings for various industrial purposes, with tables of sizes of brick and combinations to form arches and circles of various diameters, furnace temperature and other useful data on sand, Portland and natural cement. This pamphlet should be in the hands of all consumers of fire brick.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

The Michigan Portland Cement Co. gave each of its 309 employes a fat turkey for Christmas.

CEMENT TEST FOR MUNICIPALITIES AT THE NEW YORK STATE CEMENT TESTING LABORATORY.

Mr. Edward A. Bond, state engineer and surveyor of New York, will test free of charge, at the laboratory of the state engineer, at Albany, N. Y., all cement to be used on municipal public works in the state of New York, for any city engineer or other municipal official in charge of public works upon complying with the following directions:

1. Samples should be taken from different packages of the lot, say from one barrel or bag in every ten. Each sample should be taken with a long sampling iron reaching to the center of the barrel or bag.

2. The quantity of each sample should be at least 8 ozs., or enough to fill a cubical tin box measuring 3 ins. on each edge. The samples should preferably be put in such boxes, or each may be put in a bag of tough paper, securely tied.

3. The several small boxes or bags should each be plainly numbered and marked with date, and place and name of structure and name and address of official to whom report is to be sent. They should then be enclosed in a tight box and sent by express, with express charges prepaid, to Edward A. Bond, state engineer, Albany, N. Y., with a separate letter stating that such samples have been sent. Each barrel or bag from which each sample is taken should also be numbered to agree with the sample numbers.

4. The name of the maker of the cement or its trademark or brand may be given or omitted as preferred.

5. The samples will be tested for fineness, for tensile strength, for time of setting and for checking, and will also be subjected to hot water test if desired. In the tests the rules of the American Society of Civil Engineers will be followed.

6. Samples should be taken and sent at least two weeks before the time when it is desired to receive report of the result of the tests, in order to allow for time in transit, length of test, and mailing of results.

F. L. Smidth & Co., 66 Maiden Lane, New York, have issued and are distributing a pamphlet covering the points in litigation on tube mills and the finding of the German courts, together with correspondence of other German tube mill makers in Europe, with a warning notice against infringers of United States patent No. 548,-115. The pamphlet contains several illustrations showing the exact point in controversy.

A PROGRESSIVE JOURNAL.

The Tradesman of Chattanooga, Tenn, has been received and is replete with 236 pages of excellent matter, covering the industrial progress of the South, of which it is clearly the leading trade paper. It presents carefully chosen articles by writers of authority covering the iron interest of the south, recording its magnificent development, with special illustration of the Birmingham district, the cotton seed oil trade, the electrical development of the south and its application in the New Orleans drainage system. Senator John T. Morgan of Alabama and Alfred More Waddell of North Carolina contributed special articles on the race problem. *The Tradesman* has contributed largely to the awakening of the industrial progress of the South and will continue to do so while it maintains its present standurd.

The Colorado Portland Cement Co. expects to begin work about April 1.

The charter of the Northwestern Asphalt Company was annulled by the Superior court at Spokane, Wash., January 12.

The Diamond Wall Plaster Co. of Williamsport, Pa., will erect a new wall plaster plant at Garbutt, N. Y. The gypsum deposits at this point will be utilized.

Incorporated: The Peach Bottom Cement, Tile and Brick Company of Delta, Pa., with a capital stock of $100,000. The object of the company is to make a cement of the refuse slate of fifty years' accumulation. The principal offices will be at Baltimore, Md.

Incorporated: Metal Core Cement Tie Co., St. Louis. Manufacturing steel metal cores for railroad ties. Capital, $200,000. Incorporators: S. A. Walker, P. Wilkinson, W. F. Kelly, all of St. Louis; W. J. Kelly of White Cliffs, Ark.; E. D. Owen of Chicago, Ill.

The Peerless Portland Cement Co. of Union City, Mich., are expending $100,000 in improving the plant and installing the rotary kiln system. Further improvements are outlined for next spring on a new plant, to cost $150,000. The works will start up about February 15 for the season's run.

Over 1,000 acres of marl has been discovered at Decatur, Mich., extending along the line of the Michigan Central Railway. The deposit is said to be the finest in the state in quality. The Decatur *Republican*, of Decatur, Mich., will answer inquiries concerning the location, and resources in relation to the find.

The Edison Portland Cement Co. has purchased in the vicinity of Stewartsville and New Village, Pa., for its cement plant, the following acre tracts: From Mrs. R. V. Stone, 155 acres at $150 per acre; Mrs. S. Royer, 110 acres, $121 per acre; Stewart Fritts, 120 acres, $150 an acre. This is a total for the three farms of $54,560, and represents a little more than half the real estate the company designs to use.

POSITION WANTED.

An experienced cement chemist would like a position; references given. Address "A CHEMIST," care of the *Cement and Engineering News*, **161 La Salle St., Chicago, Ill.**

WANTED.—SUPERINTENDENT.

A capable young mechanical engineer as superintendent of an established Portland cement works. College graduate, familiar with rotary process of cement manufacture preferred. Address "PORTLAND," care of the *Cement and Engineering News*, **161 La Salle Street, Chicago.**

WANTED.

A SUPERINTENDENT.

One who thoroughly understands the manufacture of Portland Cement (Rotary Process). Address, stating age and experience. All communications will be held strictly confidential.

DANIEL PIERSON, JR.,
874 Broad St., Newark, N. J.

WANTED.—Correspondence is solicited with manufacturers or importers of Portland cements, desirous of introducing or maintaining the sale of their products in the West and Southwest for the season of 1900. All correspondence treated confidentially. Address, "WAREHOUSE," care of the *Cement and Engineering News*, **161 La Salle Street, Chicago, Ill.**

A TREATISE
ON
Masonry Construction.

By Ira O. Baker, C. E.,

Professor Civil Engineering, University of Illinois; Member American Society of Civil Engineers; Member Western Society of Engineers, etc.

Six hundred and two and xv pp.; 160 figures, many of them full page; 6 folding plates; 97 tables of cost, strength, contents, etc. Coplous index. The book contains the results of a great number of experiments and a large amount of practical data on the cost of masonry, pile-driving, foundations, culverts, etc., and also many tables of contents to facilitate the making of estimates. The data on cement testing, sand, gravel and broken stone, thoroughly covers the subject from a practical standpoint; all prepared especially for this volume. Also an appendix with standard specifications for all kinds of masonry for various purposes.

Ninth Edition. Cloth, 6 x 9 Inches.

PRICE, $5.00.

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LINK-BELT Conveying and Elevating Machinery

for handling Limestone, Clinkers, Cement, Phosphate, Crushed Stone, Sand, Stucco, Gravel, Lime, etc.

EMPLOYING THE

"Link-Belt" Patent Cast-Iron Screw Conveyor, Endless Trough Conveyor, "Ley" Patent Steel Bushed Chains, etc.

MANILA ROPE POWER TRANSMISSIONS, SHAFTING, PULLEYS, CLUTCHES, ETC.

PLANTS RECENTLY EQUIPPED IN THE WEST:

Bronson Portland Cement Co., Bronson, Mich.

Illinois Steel Co. (two plants), Chicago, Ill.

Chicago Portland Cement Co., Oglesby, Ill.

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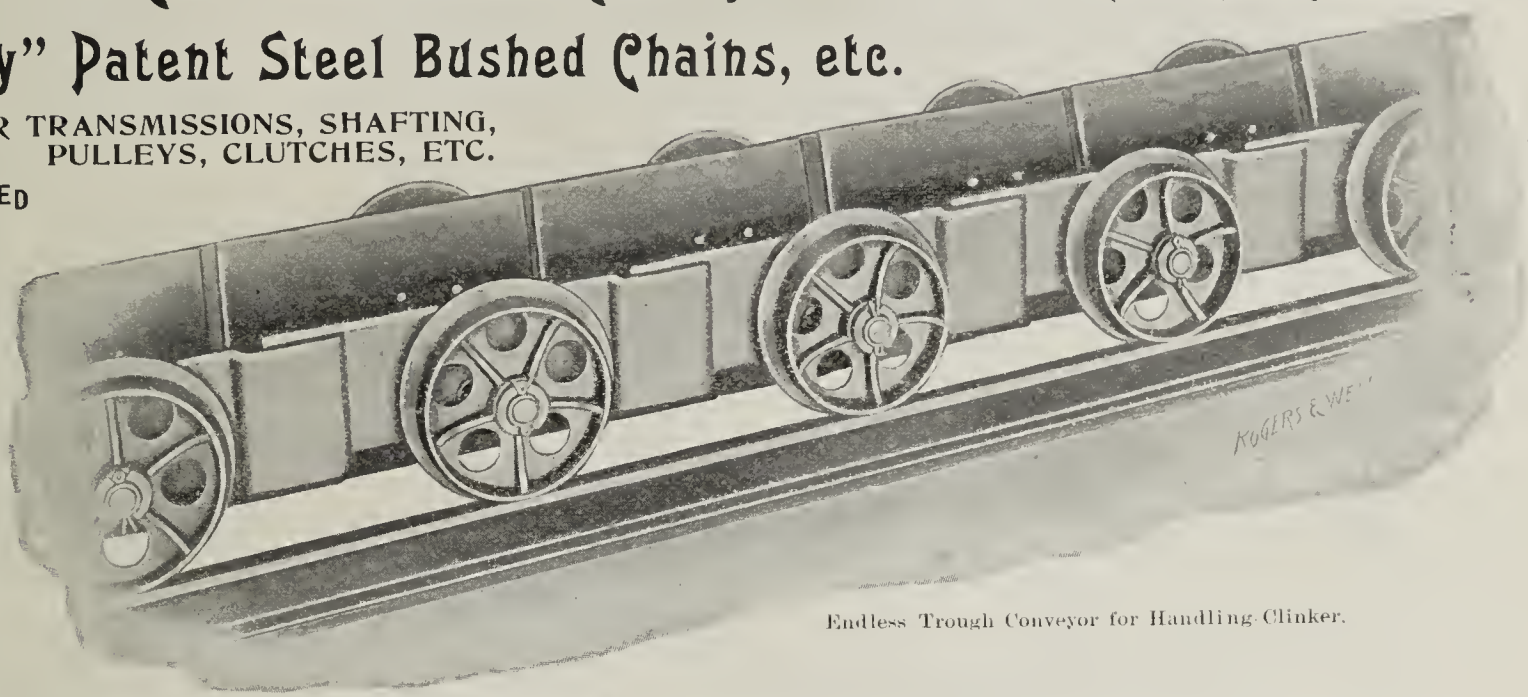
Carl Prussing Cement Works, La Salle, Ill.

Send for Catalogue.



Endless Trough Conveyor for Handling Clinker.

Link-Belt Machinery Co. Engineers • Founders • Machinists

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WORN SIDEWALKS RESTORED.

To repair and level up Freestone Sidewalks that have worn concave, or in a hollow, by cutting the stone and covering it with Portland Cement, in a manner proper for that purpose. We refer to that class of sidewalks where the ends of thick blocks of stone rest on walls, and reach from the area grating, or prismatic lights, to the gutter or street roadway, having a small room or coal vault underneath.

Our Process

not only makes the sidewalk again level, but restores it to its original appearance and strength, and gives it a surface that is

Three Times as Durable as the Freestone.

The expense of the work is but one-third of the cost of laying new freestone blocks.

State and County Right For Sale at Reasonable Rates.

The Patent is dated July 2nd, 1889, No. 406,289.

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THE CHAS. KUHL ARTIFICIAL STONE CO.

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WANTED.

Position as Foreman in Portland Cement works by a practical engineer, having a thorough knowledge of the manufacture and testing of cement; six years in present situation; references given. Address "PROGRESSIVE," care of the *Cement and Engineering News*, 161 La Salle Street, Chicago, Ill.

ISTHMUS OF PANAMA,

NICARAGUA CANAL ROUTES,

WITH MAPS.

BY THOMAS WRIGHT HURST, CHICAGO.

This work covers a period of 389 years from the first settlement of Darien in 1509 to the present year, 1898, dealing with the Spanish and Scotch colonies, locating Darien and the various explorations and surveys to locate a canal across the Isthmus, including the exploration of Lieut. Strain, U. S. Navy; Dr. Edward Cullen; Commander Prevost Royal Navy; Lionel Gisborne, C. E.; Commander Selfridge, U. S. Navy; Col. Child's Survey for Mr. Vanderbilt and associates; explorations of Dr. Caldwell, U. S. Navy; and other pertinnet data on the Great American Isthmus useful for reference.

The facts presented favor the Darien Inter-Ocean Canal as originally projected by Wm. Patterson, Esq., founder of the Bank of England.

Price, $2.00; Postpaid.

MACHINERY WANTED.

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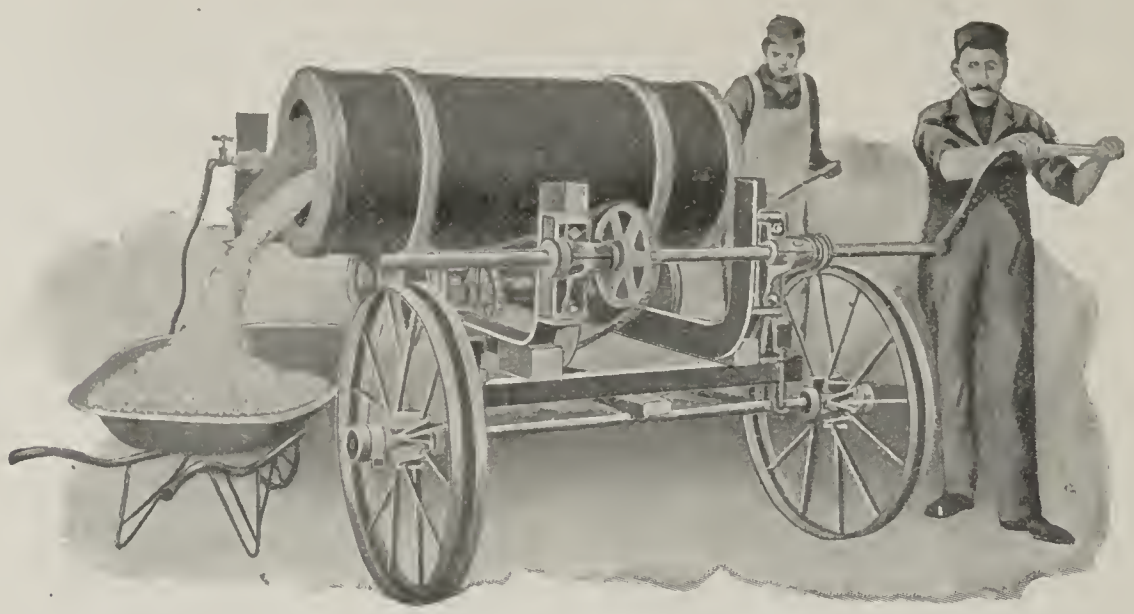

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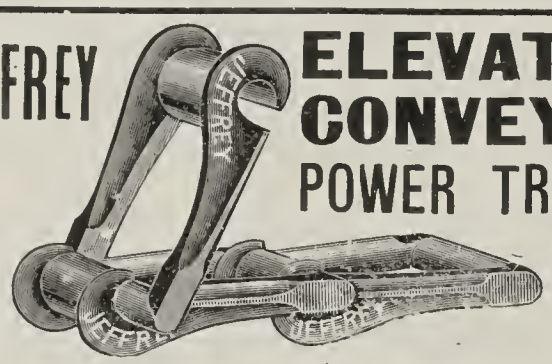

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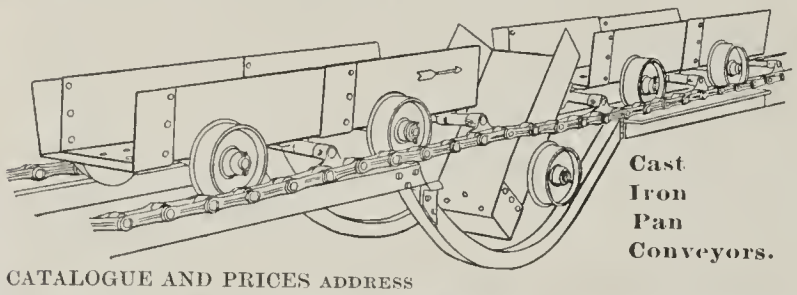

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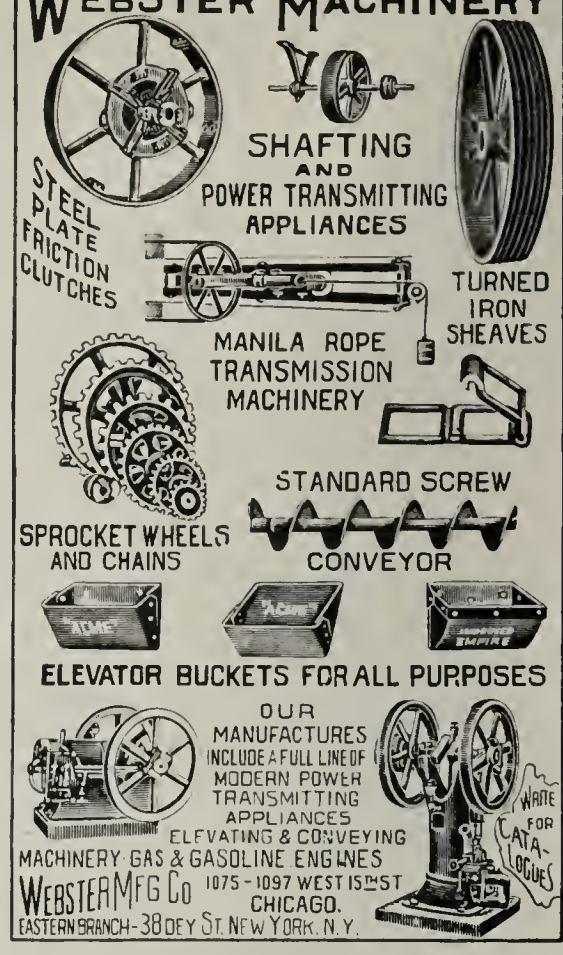

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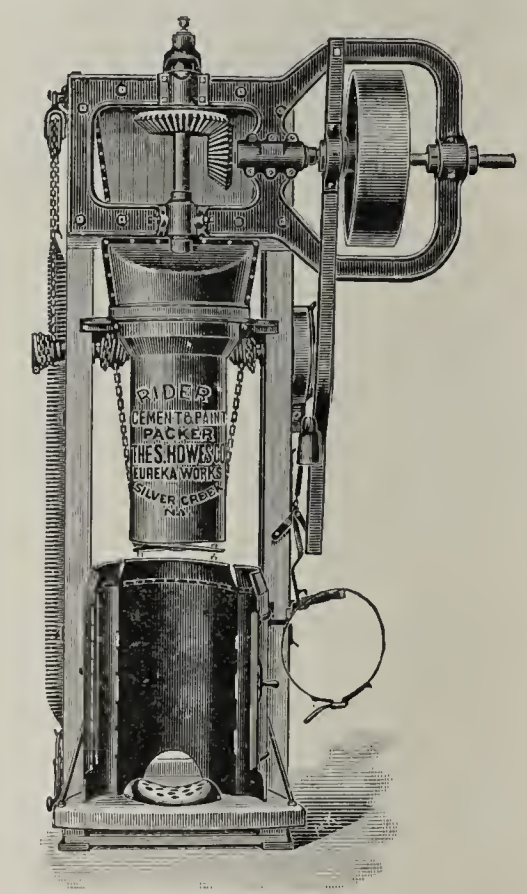

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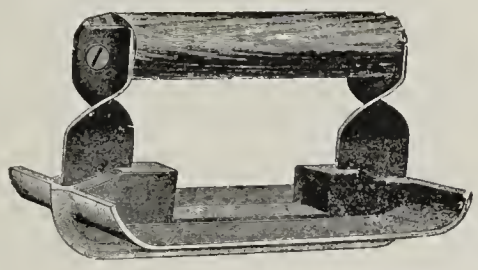

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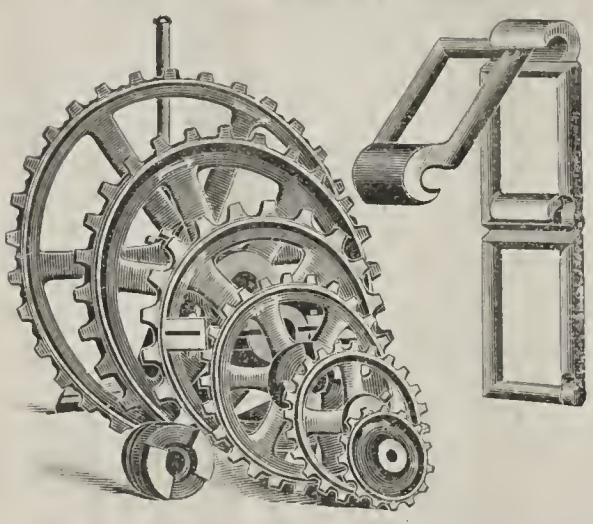

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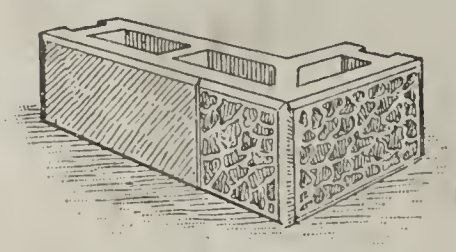

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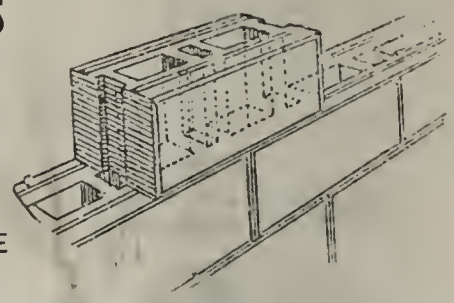

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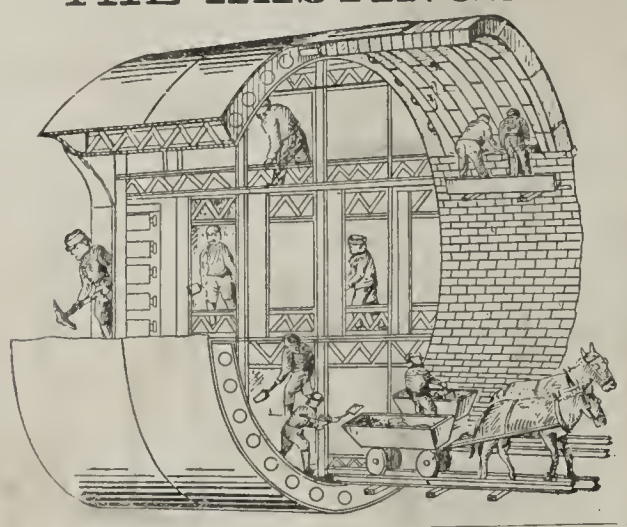

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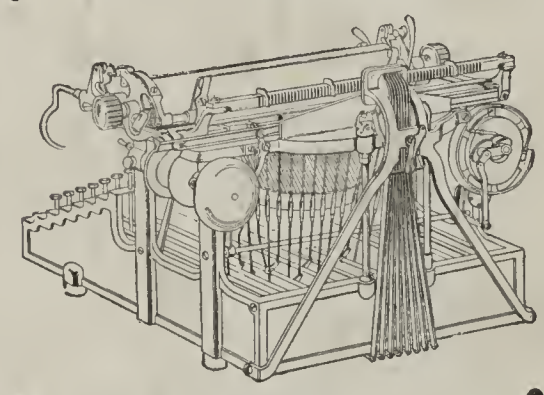

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SUPPLEMENT TO

CEMENT AND ENGINEERING NEWS

VOL. VIII. CHICAGO, ILL., JANUARY, 1900. No. 1.

AT the close of this most progressive century in the world's history it is fitting that we take a look behind and cast a glance ahead, and while recalling some of the most striking improvements of the past, endeavor to foretell the course of future progress along architectural lines. The science of building seems to have reached the acme at the present time, yet who can tell what the twentieth century may bring forth? There are depths unsounded and heights unscaled.

The variations of a century in building may be well seen and contrasted in New York city, which still contains many of the old-style buildings, so that it is a rare museum for the student of commercial architecture. On the other hand, her giant buildings of recent years exhibit in a high degree the application of modern ideas of architecture to business purposes.

It is a mistake to suppose that this progress is the result of anything more creditable than business necessity and individual shrewdness. The tendency of the times to centralization is responsible for nearly all we have of architectural improvement in modern cities. This tendency has brought about greatly enhanced values of real estate and consequent economy of space as exemplified in the high building. It is responsible for the system of rapid-running elevators, modern heating appliances and electric light, but primarily for the perfection of fireproofing. The world has learned that, in the matter of fire, prevention is better than cure, and that the best fireproof construction is none too good. Protection to human life demands that the sky-scraper must be absolutely safe in this regard, and so necessity has become the mother of that most remarkable modern invention in the architectural world — absolute fireproofing.

In the following pages the subject of modern building construction will be found discussed by eminent specialists in the various departments of design and execution. The publishers have thought it appropriate at this time to reap the field of experience by grouping into one volume the best thoughts of leading writers on the various topics hereinafter treated, with the view to present to the architects of this country and the world the consensus of opinion, as it were, on these most important subjects. The question, What are the essentials of a first-class modern building? will find its answer here in unequivocal terms, because answered by experts, each an authority on the particular branch of the art which he represents. It is this acknowledged high standing of the authorities here represented that makes this little treatise of the utmost value to all students of the latest achievements in architecture.

On the subject of the "sky-scraper" we are favored with a very complete and lucid article from the pen of Mr. W. L. B. Jenney. Having originated this style of construction some years ago, when it was an untried experiment, Mr. Jenney not only writes from a peculiarly original standpoint, but also recounts some very interesting experiences. He sets forth an episode in an architect's life that can not fail to be of great interest to every other architect, for he tells of difficulties encountered and overcome, and of pioneer work along an original line — work that has proved to be eminently successful, inasmuch as it has fairly revolutionized the construction of a most important class of commercial buildings. Not only is Mr. Jenney's article authoritative, but it is exhaustive, and will be a permanent contribution to the literature of fireproof construction.

The principal subjects in the discussion of modern methods — steel frame, fireproofing, elevators, electricity, heating, decoration, etc. — have been treated in this supplement at some length, and with great care as to exactness, by the several writers. While the science of fireproofing antedated that of steel construction, yet it came in with the era of high buildings as a necessary accompaniment of their safety. Without it there could be no high buildings, for obvious reasons, which are treated more fully in later pages. The same may be said of the rapid elevator service, and to a large extent of the electric lighting. All of the important accompaniments of construction which are now considered so indispensable to the up-to-date building were introduced, because there was a demand for them in the growth of the building idea. They came as a logical result of the evolution in architecture which could not brook antiquated or doubtful methods. The business world has learned that the best was the cheapest in fact as well as in theory, and a very influential part of that world insisted on having the fact.

Still other changes have come and are coming. The matter of fireproofing is bringing about a general substitution of materials — iron for wood and glass for iron — as exemplified in the making of iron window frames and the use of glass prisms and wire glass in the place of iron shutters. Decoration also was revolutionized. Exteriors must depend upon forms of terra-cotta and brick and metal for adornment, and interiors now employ grilles and marble and tiles where formerly wood was used. All this means an entire overturning of the manufacturing ideas of the past and the substitution of new designs, marked out in new factories for the future; and it is the object of this supplement to set forth in as intelligible and authoritative a manner as possible the details of all these several changes.

What the future holds in store for the building world can be best surmised from its probable necessities. Economy of light and space will be accentuated. The tendency to combinations of commercial interests will call for buildings covering a greater ground area, rather than for structures of increased height. The growth of the commercial world in wealth and in the appreciation of art will foster the ornamental in every surface detail of construction, which will create a demand for new materials and for new adaptation of old materials in endless profusion. It were a mistake to suppose that we are far beyond the threshold of the art as yet. The patient student and aspiring inventor, who looks to the needs of the coming century, as evidenced by the progress of the times along all lines, will achieve new triumphs in architecture.

THE STEEL SKELETON, OR THE MODERN SKY-SCRAPERS.—THE ENGINEERING PROBLEMS.

BY W. L. B. JENNEY, ARCHITECT, CHICAGO.

To the Editor:

In reply to your request for an article on the best modern practice in the leading lines of steel building construction, I respectfully beg leave to submit the following.

W. L. B. JENNEY, Architect.

IN 1883 and 1884, when the problem of building a tall, well-lighted, fireproof office building, with all modern conveniences, and a reasonable amount of elegance, was first presented to the writer by the Home Insurance Company of New York, for their building, then about to be erected on the northeast corner of Adams and La Salle streets, Chicago, to be known as the Home Insurance building, it was an entirely new one, one may truly say, in every particular; and for the new building everything must be invented, particularly the system of construction.

The soil on which the footings must rest was a soft, wet, compressible clay of great depth — probably about sixty feet — that could not safely carry over 4,000 pounds per square foot of surface. With the ordinary construction there was not room beneath the building for the foundations.

The many windows for the lighting of the offices so reduced the piers between openings that they were insufficient in the lower stories to carry the load of walls and floors above.

The building was to be so tall that the question of wind pressure must be considered.

Elevators passed at once from a luxury to an absolute necessity. They must be so constructed as to be unquestionably safe and at the same time rapid-running. The heavy wooden car must be replaced by a light iron one of elegant design and finish.

The fireproofing must be of the highest efficiency, for the upper stories would be entirely beyond the reach of the fire department.

As the owners were catering to the highest order of tenants — eminent lawyers and large corporations that could well afford to pay large rent, which they were willing to do provided they obtained better quarters than could be obtained elsewhere — in order to attract such tenants it was necessary to provide the business necessities, such as plenty of electric light, then just coming into general use, safety vaults, coat closets and neat wash-basins. There must be a freight elevator conveniently placed for the use of large corporations, for the taking in and sending out of stationery, etc.

All this required something heretofore unknown, but the old saying that "necessity is the mother of invention" is as true today as ever it was, and in the new Home Insurance building all these new requirements were in a measure provided by the writer, who had been selected by the Home Insurance Company as its architect. The new skeleton construction made the tall building possible. Chicago adopted it at once, and soon Messrs. Holabird and Roche, both of whom had formerly assisted the writer in his office, designed and erected the Tacoma building, northeast corner of Madison and La Salle streets, Chicago. This building occupied a lot of very restricted dimensions, which induced the architects to enlarge the offices by covering the street fronts with towers of bay windows, projecting out over the sidewalk. Little by little the new Chicago Construction, as it was then called, spread eastward, wherever the value of the land made tall buildings desirable, and soon New York city, in the use of the Chicago Construction, in height and number of buildings passed far beyond anything to be found in Chicago.

Since the introduction of the skeleton construction the writer, and many other architects and engineers, have steadily worked to perfect, to improve and to economize, so that the construction today differs from that of 1885 in many respects, particularly in the details.

I propose to pass in review the present methods that may be characterized as the best modern practice.

FOUNDATIONS.

These vary greatly according to the material on which the footings rest. The simplest problem is when solid rock underlies the building. In this case it is only necessary to dress off the rock at the proper level to receive the stool of the column.

In the business district of Chicago the underlying stratum on which all the buildings rest is a very thick stratum of soft, wet, compressible clay. Experience, that best of all teachers, has demonstrated that it is not well to exceed a load of 3,500 pounds per square foot on this clay. This load will cause a settlement of about 2 or 2½ inches that will obtain mostly during the construction of the building, and if the loads are carefully calculated so that the load is uniform on the clay at all the footings, the settlement is practically uniform, and if the sidewalk line is set up two inches at the outset of building, no inconvenience will result. Within a year after the completion of the building, the sidewalk floor will be practically at the level intended.

Caution.— The contractor should not be allowed to overload any portion of the building during construction, by concentrating a large quantity of heavy material on a small area, as is too often done.

In office buildings, hotels, and apartment houses, where the live load is very light, no account is taken of the live load in calculating the footings, but if the building is to be used as a warehouse, every endeavor must be made to learn as near as practicable the actual load that will obtain when the building is in use. This is often very difficult, especially if the building is for rent, as it is quite impossible to know in advance what a tenant, not yet procured, may put into the building; still, some assumption must be made, and a live load decided upon, and the owners instructed to make it a part of the lease that the load used in the calculations shall not be exceeded. The neglect of this has caused, in several instances that have come to the writer's notice, very serious results. In one instance, the second story was so overloaded with stoves and stove castings that the floor gave way, and the whole second floor and its load were found one Monday morning in the basement. No one was in the building at the time of the disaster. In another instance one part of the building was so overloaded that the columns under the load were forced down over two feet.

If the building is to be used for running machinery or printing presses, the actual loads must be largely increased; usually it is not safe to use less than the double for the calculations, for a moving load produces a jar that is equivalent to pounding, which will produce a lasting effect. In one instance the writer watched, when a large steam engine was running near a column, the column continued to settle for two or three years, when the engine was removed.

A Chicago office building, located so much to one side of the proper business district that it was not sought by tenants for offices, was leased in part to a large printing establishment. After the presses had been running for a couple of years, it was found that the injury to the building was becoming so serious that the owner bought off the tenant, giving him some $4,000 bonus, it was stated, to give up his lease and leave the building.

In New York city one floor of printing-presses fell into the basement of a building. An investigation was made; the investigators recommended that thereafter all large printing-presses should rest directly and independently on the ground, and not in any way connected with the building

Between the solid rock and the soft clay of Chicago are all the known varieties of underlying strata. A careful examination by borings under each footing should be made, and the load that can safely be put on the underlying strata determined. Often it is desirable to make a test. This is easiest done by setting a post on the material at the level of the underside of the

footings. For convenience, let the post be 12 by 12 inches in cross section. On the top of the post build a floor of cross-timbers and plank, on which set a tank, which must be guyed to prevent tipping.

Take the level of top of tank and refer it to a bench-mark that will not be disturbed. Then fill the tank with water and calculate the load on the square foot under the bottom of the post. The tank should be large enough to give a maximum

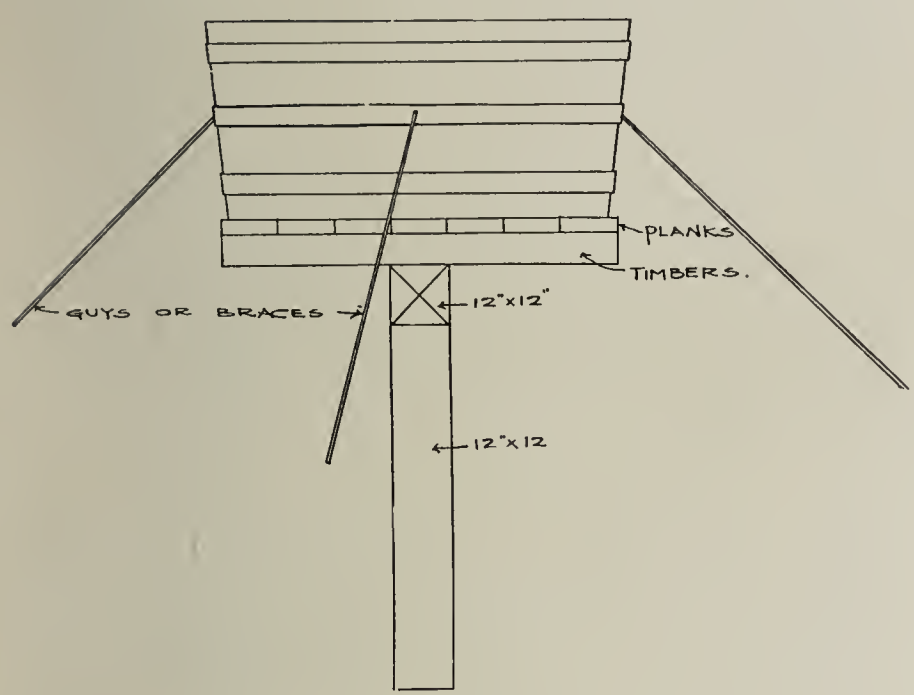


FIG. 1.

load, not less than 4,000 pounds is preferable, if the stratum is soft clay. If of hard material the test is usually unnecessary. Time is an element in the experiment, for if the stratum tested is like that underlying Chicago, a load of 4,000 pounds per square foot will show but small results the first week; still, if the operator is experienced, some valuable information can be obtained. It is especially valuable when there is liable to be soft places, such as pockets of quicksand, or an old slough filled with muck. This method of testing the material on which the Chicago World's Fair buildings were placed, proved very valuable. Here the underlying stratum was very variable, and many very soft spots were detected. In addition the tests gave the relative settlements that might be expected in the harder parts, so that the dimensions of the footings, which were piles in soft spots, and timber grillage elsewhere, were proportioned in accord with the tests indicated. The results were very satisfactory.

Pile foundations are comparatively inexpensive and reliable, whenever the tops of the piles can be kept permanently immersed, while if they are alternately wet and dry they soon decay, with disastrous results. An examination must be made at the dryest season by an excavation or by boring to learn where it is safe to saw off the piles with the assurance that they will be permanently wet.

After the piles are driven, which is done after the excavation is made that the pile may be used the entire length and not be wasted in any considerable part, the tips are sawed off, and a pier of good Portland cement concrete put in place, as illustrated by Fig. 2, on top of which set the column stool at proper level. In the new Field building, northwest corner Adams and Clark streets, Chicago, the piles were cut off about thirty-four feet below the sidewalk. The piles used are driven fifty-five feet and only a foot or two is wasted by the cutting off to receive the concrete. In this case the foundations were so large that it was necessary to introduce a steel beam grillage between the bed of concrete covering the tops of the posts and the column stools.

STEEL AND CONCRETE CYLINDERS.

It often occurs that some footings are so near to other buildings that the driving of piles would be injurious to the neighbor. In such cases a pier of steel and concrete is used. Steel cylinders are provided the full width of the steel sheet in height, riveted together at the laps. These are placed with center of the circle over center of footing and excavation begun. The steel cylinder is pushed down as the excavation progresses. When one cylinder is mostly below the surface another is added and joined to the one below as shown in Fig. 3.

At the Field bank building the concrete cylinders go down to the hard clay, which is also the depth to which the piles are driven. In this case, only the top steel cylinder was used and then sheet piling as shown in Fig. 4. These cylinders are filled with concrete dumped in from the top. The upper courses are rammed solid. The top of the pier receives the column stool.

GRILLAGE.

When the underlying stratum is not too soft, and when so situated as not to have connection with permanent water, that would make pile foundations desirable, the usual foundation is steel grillage, which, as the writer believes, was first used by D. H. Burnham in the Rookery building, Chicago. (See Fig. 5.) The beams are laid on a bed of concrete, the usual proportions being: one best Portland cement, three clean sharp gravel, three to five aggregate of broken stone, egg size.

The excavation must extend to the best underlying material available. The concrete should not be less than twelve inches thick. Too great offsets beyond the beams should be avoided; plank boxes are placed and the concrete rammed into place, finishing the entire mass before any part has set. To this end everything should be ready and enough men put on to accomplish the object.

With regard to the calculation of the beams, two methods are in use. One assumes that the beam is immovably fixed from outer edge of flange of cross-beams *b* to *a* (Fig. 5), using *a b* as the lever arm, *c* being center of the system of cross-beams. It is probable that the exact fact lies somewhere

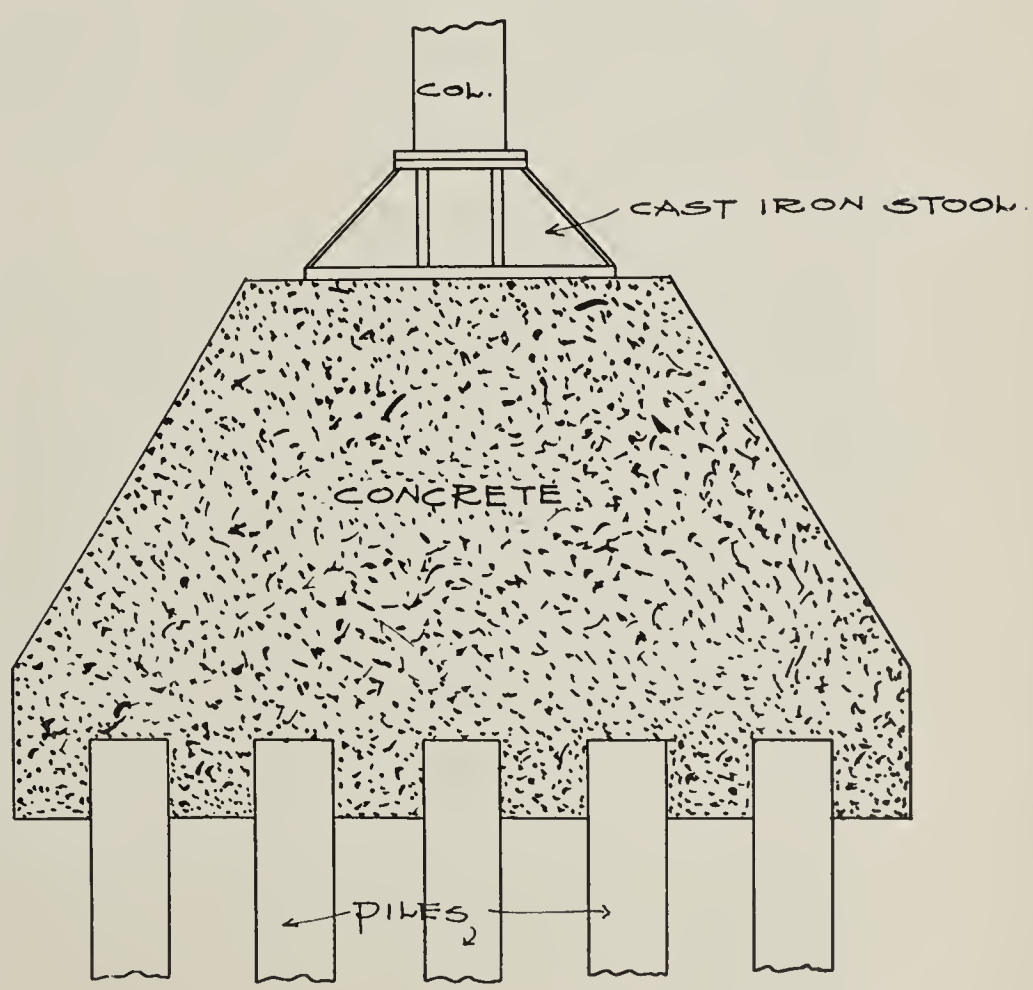


FIG. 2.

between. In his own practice the writer uses *a c* for the lever arm, as certainly the safer, and the addition in amount of steel is not great enough to be objectionable, particularly in foundations.

Owing to the liability to rust, although every care is taken to prevent it by the use of paint and concrete protection, very

light web beams should not be used. Better use the heavy sections, for an excess of steel is rather desirable in the foundations.

There should be three lines of separators and rods in each system of beams, one in center and one at each end.

The footings should be entirely imbedded in excellent concrete which should be well rammed in between beams. For

FIG. 3.

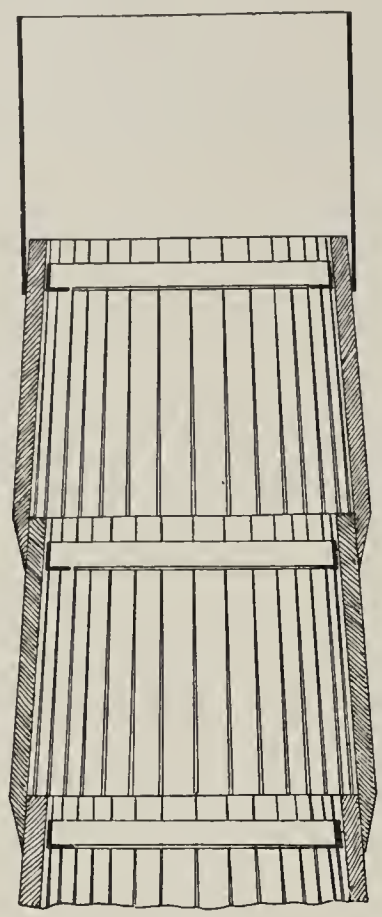


FIG. 4.

between beams the writer recommends one part best Portland cement and three parts clean sharp torpedo sand, that the concrete may replace as far as practicable any loss by decay of beams, should such occur.

COLUMNS.

The spacing of the columns is of first importance. They should be placed where least objectionable. The bank room is much benefited by reducing the number of columns standing free in the room to the minimum. It is well known that an increase of span of beams increases cost of the steel; still, it should be calculated, and if, in the opinion of those best capable of judging correctly, the increase in rental will pay a reasonable interest on the increased cost, then this increase in cost should be accepted as desirable, for the less number of columns standing free in the room will make it easier to rent the room, and avoid the complaint that is sure to obtain if there are many columns, seemingly in the way. It is true the objection to columns is usually much exaggerated; still, we must accept the situation as we find it. It is a good rule to reduce the number and size of the columns standing free in the large rooms to the minimum.

Among the numerous column sections that might be used, in order to decide which to choose, calculations and diagrams should be made of each of these, and the section that, under the circumstances, all things considered, is best adapted to the situation, from a constructive and from an economical point of view, should be adopted.

WIND BRACING.

If the building is exposed to the wind, then the columns had best be above basement, each two stories high, jointing the columns one-half in each story. Then one-half in basement will be one story high and those on top story should go through the roof space. All others are two stories in height. The favorite junction for columns is now the splice joints. See Fig 6. Thirty pounds per square foot of exposed surfaces is usually used in calculating the wind pressure.

The wind pressure on the exposed parts of the building, as per recent experiments in England, is less per square foot on large surfaces than on small. It was found by actual test that the pressure on one square foot was more than $\frac{1}{100}$ of the pressure on 100 square feet. It is argued that on a single foot square the air is quickly blown off, while on a large area the air is held against the surface, forming an elastic cushion that to some extent resists and diminishes the wind pressure. The interior columns, together with the rigid floor construction, will take care of about one-fourth to one-third of the total wind pressure, depending on depth of beams, system of construction and the general floor construction. The balance must be cared for by the exterior columns and by wind bracing in permanent unchangeable partitions of the interior. The columns in the direction of the wind in exposed walls may be enlarged, and the junctions of columns with the exterior beams of floors may be connected by gusset plates (see Fig. 7), and such exterior beams made sufficiently large to resist the stresses occasioned by the wind.

PENTHOUSES

Are usually necessary on the roof for inclosing water tanks, elevator overhead work, photograph gallery, etc. These should be built with a steel frame and brick. The ordinary hollow-tile partition with the exterior or exposed surface glazed is also good, if tile are sufficiently thick to lay up into a substantial wall, but the ordinary 3 or 4 inch partition tile does not make a substantial exterior wall.

SIDEWALKS.

The sidewalks are made either of dressed stone or vault covers of concrete, either with brick or concrete arches between beams. In either case there are sidewalk beams supporting the sidewalk extending from the exterior outside columns or the beams between exterior columns, across the vault to the curb wall. These vault beams brace the building to the curb, which is in turn sustained by the street, making a very rigid construction.

Some years ago, when the Chicago City Council ordered a revised building ordinance, it unfortunately was entrusted to

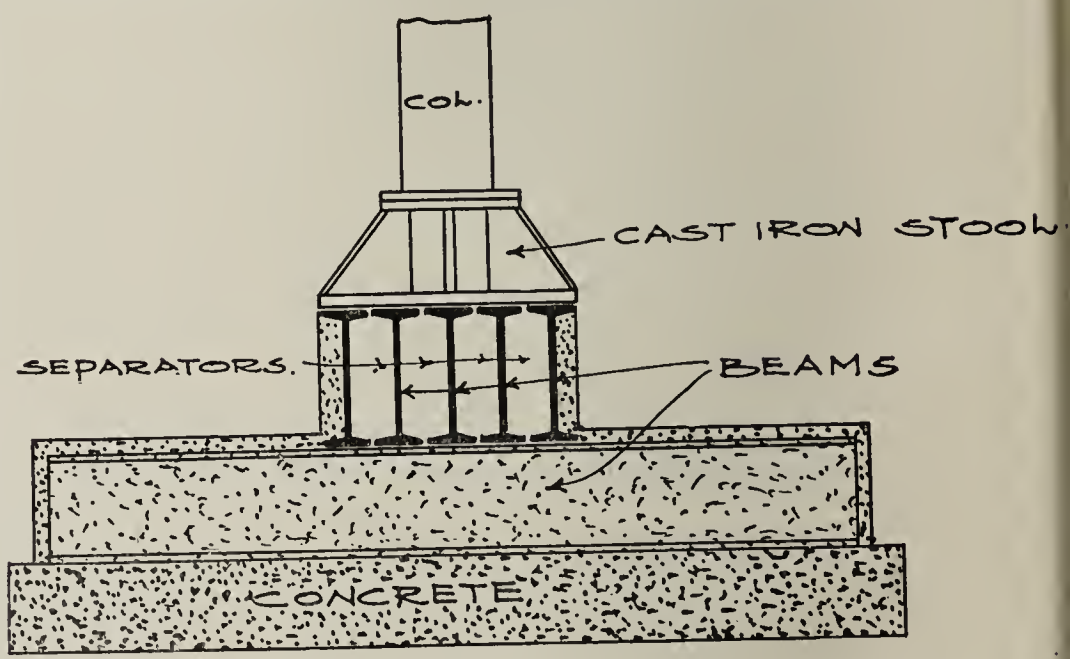


FIG. 5.

those who did not fully appreciate the skeleton construction (which was discriminated against by the new ordinance), and who considered the skeleton construction less stable than the old-fashioned masonry walls. Because these masonry walls were heavier than those of the skeleton construction, the ordinance assumed that the common masonry construction was the more substantial, while the contrary is the case. The skeleton construction is put together with hot rivets. Every part is carefully calculated, every possible stress is provided for by a proper

resistance, with all the care and all the science that would be applied to a cantilever railroad bridge over the falls of Niagara. The skeleton construction closely resembles steel bridges standing on end.

The Monadnock building, Chicago, is very long north and south, while the width east and west is only some 80 feet; the height is sixteen stories — over 150 feet. The north half of the building was built before the south half, and is of the old-fashioned masonry construction, with walls some five feet thick in lowest story. At this time the skeleton construction was in its infancy, and the owners, who resided in Boston, thought it

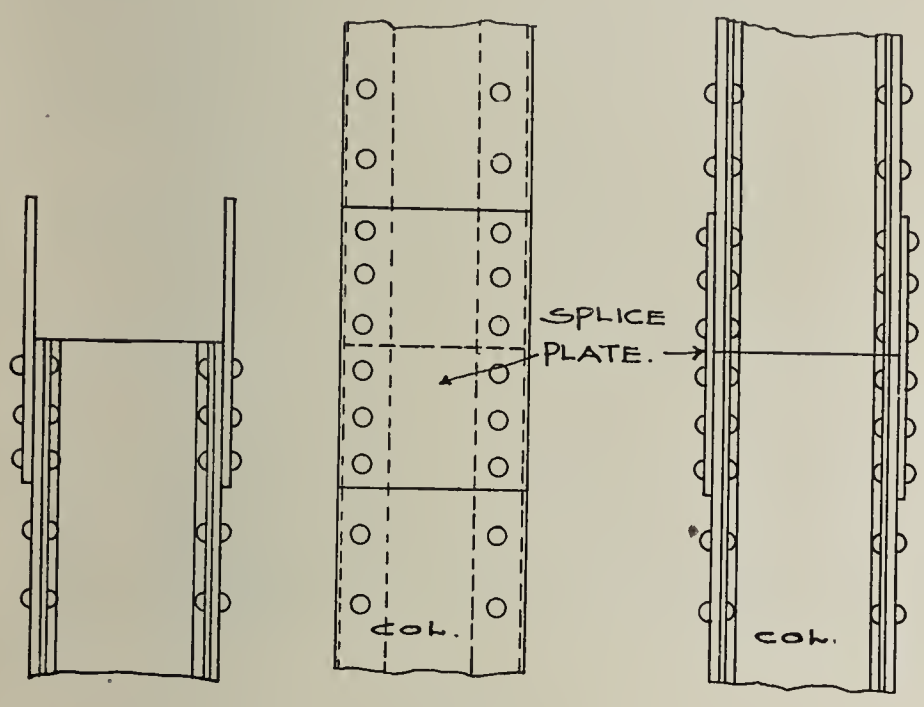


FIG. 6.

an experiment that it was not as yet advisable to adopt. Later, when the south half was built, the skeleton construction was used. Here was an excellent opportunity to compare the two systems.

The cost of the north half, old-fashioned masonry construction, was 42 cents per cubic foot, while the skeleton cost but 39 cents, the number of feet calculated from bottom of footings to top of roof with the space under sidewalks added.

The agent, desirous of settling the question of relative stability, employed some experts to make the test whenever a favorable opportunity arrived. This soon occurred, when a gale blowing from the east, of extraordinary severity, lasted some three days. The experts reported that the maximum vibration at top of cornice varied from the perpendicular about ⅜ of an inch — that it was a little more in the masonry construction than in the skeleton, and that there was less apparent jar in the skeleton than in the masonry portion.

It may be safely asserted that the steel skeleton construction, in the hands of experienced experts, is cyclone-proof, earthquake-proof, lightning-proof and fireproof. The entire skeleton is a lightning protector assembled together so intimately that the lightning striking the building is carried off harmlessly. During a heavy thunderstorm the Home Insurance building, Chicago, was struck on the northeast or alley corner. The only apparent effect was the tearing off of a few brick that covered the top of the column at that point. The writer was in the top story of the building at the time and experienced no sensation of the shock.

In a locality liable to earthquakes the exterior covering, which had best be of terra-cotta, should be very securely anchored to the steel, so as not to be easily shaken off. Unless the shock was very severe the building would not be injured.

Where the building is to be filled with inflammable goods, special care should be taken with the fireproofing particularly, to prevent its being stripped off by the shock of the water thrown by the fire engines.

FIREPROOFING.

The most usual fireproofing for stores, warehouses, bank and office buildings, and for tall buildings in general, is the hollow tile arches, end construction — that is, the resistance is in the direction of the webs, or subdivisions. The tile should be laid in strong Portland cement mortar; one to three is recommended. Every joint must be filled or there will be cracks in the plastering along the lines of the partially filled joints, as has occurred in so many buildings.

For hotels, apartment houses and dwellings, where wind bracing is not essential, the Roebling, the Expanded Metal and Concrete and other similar fireproofing systems may be used, particularly if the horizontal area of the building is large in proportion to the height, for these systems do not give the same rigidity to the floors as obtains with the tile arches. They are, however, of light weight, and allow of a corresponding reduction in weight of steel construction. Under favorable circumstances these systems will probably effect a reduction in cost.

Where concrete floors are admissible the concrete on top of the floor construction is finished off smooth with strong concrete, one of Portland to one of clean sharp sand, or better, crushed granite or crushed quartz. Where wooden floors are used wooden floor strips are laid, say, 1¾ inches thick, about 12 inches from centers. Formerly these strips were cut, dovetailed and filled in between with concrete, both to hold the strips and to fill the space between the strips. A difficulty was experienced; the floor strips would shrink and strips loosen, and the concrete filling would not become sufficiently dry before floor was laid, causing the swelling of the floor, which in office buildings and stores was usually maple. This maple floor was often seriously injured by the dampness in the concrete filling.

The writer has induced an insulating company of Chicago to prepare a pad composed of their insulating material — special mineral wool and asbestos, compressed to the proper width and thickness — to just fill the space between the floor strips,

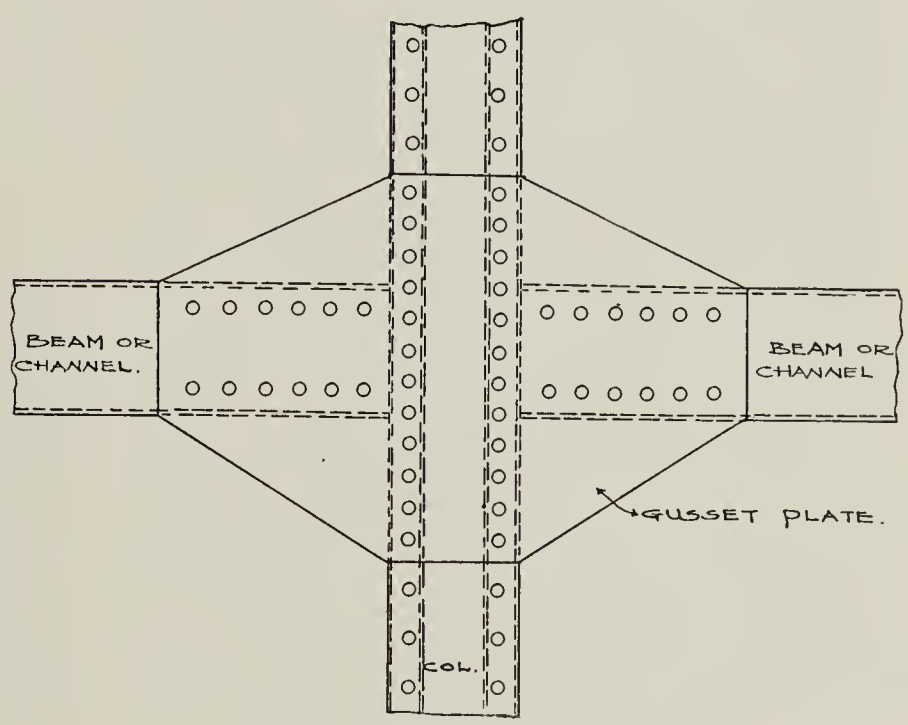


FIG. 7.

which are clamped to the floor beams. This is found to serve an admirable purpose, and the small additional cost is not to be considered, as compared to the advantages of a fine floor and thorough insulating and deafening; in fact, it is a saving whenever it would otherwise have been necessary to repair and in part relay the maple floor, as has been the case where haste in laying the hardwood floors was essential.

PARTITIONS.

The usual partition has heretofore been hollow tile three or four inches thick, according to the height. At the present time many partitions are made by setting up light steel channels ¾ to 1½ inches or more, in proportion to the height and use.

On one side of these channels expanded-metal or wire lathing is attached and plastered, and the other side is filled in with concrete and plastered, making a solid partition of about 1½ to 2 inches in thickness. These partitions are sometimes set double. Then the concrete filling is omitted and the exposed surfaces plastered on metal lathing.

Whatever system is used it should be tested by heating an experimental piece to redness and then plunging in water.

Several kinds of tile have been manufactured from plaster of paris, but as far as I have tested them they will not stand the test of heat and water. It is necessary that, in case of a fire, they should not only resist the fire but the fire department at the same time. At the great Pittsburg fire, some two years ago, the inspectors reported that large areas of partitions had disappeared before the fire department, leaving very little debris. The firemen testified that the partitions seemed to blow away when struck by the water.

Fireproofing of columns may be either by tile or by expanded or other metal lathing. If of tile, the tile is molded to fit the column, for which a full-sized section is made. These tile may be single or double according to the fire resistance required. It is very essential that the tile be so substantially secured that it will not be knocked off by the shock of the water during a fire. At the Pittsburg fire about one-half of the column coverings were stripped off; still the rigid inspection after the fire failed to detect any serious injury to the columns. It is probable that the fireproofing was stripped off the columns when struck by the stream of water from the fire engine, and from that time was constantly subjected to a deluge of water that prevented any overheating.

Columns are also fireproofed by wrapping expanded-metal or other metal lathing around the column and plastering. Then a furring system is put on and another layer of metal lathing and plastering. This, if well done, is probably safer than a single layer of hollow tile as usually put on. It is good practice to fill the columns and the stools with concrete, well rammed in place as the columns are set. This prevents interior rusting and strengthens the columns.

It is often desirable to run the water-supply and the waste pipes for the plumbing of the offices along the columns in the fireproofing. A full-size section should be prepared for the fireproofing and for the plumbing contractors.

The supply and waste pipes of the principal toilet rooms can usually be run in a channel in the wall of the building. In either case, arrangements must be provided for reaching these pipes whenever required. Steam pipes are often run in the same pockets with the plumbing pipes, for they are unsightly and objectionable when exposed in the rooms. All plumbing fixtures should be the best the market affords, and all work, both for plumbing and steam, should be the best and most substantial. It is a serious mistake to attempt to economize at the expense of quality or durability. Great reliance must be placed upon the contractors for this work. It should be stipulated that a reliable foreman should be constantly on the work, or, better still, the owner should employ an expert plumber, steamfitter and electrician to keep the closest watch on the work in his interest, for the opportunity for covering up bad work is abundant. Often this bad work is only found out when too late to obtain any redress from the contractor. The guarantee may have expired or the contractor may have gone out of business, or left the city. The only safety is to have the work done right in the first instance.

For the electric work the owner would certainly do well to employ an expert to assist his architect, for the whole subject is so new, and often so obscure, that the architect can not be expected to be "up to date" in all particulars. Neither he nor his superintendent can be expected to know if the details of workmanship are in accord with the specifications, nor can they be expected to make the tests from time to time as work progresses. If the building has its own electric plant an expert should assist the architect in locating the plant, and in the specifications for the dynamos, engines, etc. It is not well to rely upon one dynamo for the entire work when running at its maximum capacity; it is best to have two or three of different power, so arranged as to be switched into and out of use without disturbing the lights.

THE SHONE EJECTOR.

It is often the case that the basement or subbasement floors are below the city sewerage. In that case the drainage and the plumbing and steam wastes of the lower story must be collected and lifted into the street sewer. This is usually done by the Shone Ejector, that may be operated by either steam or electricity. There is another sewerage lift that has recently come on the market that under certain circumstances may be desirable. The architect would do well to study the two systems and see which, all things considered, is best adapted to the case in question.

VAULTS.

Should safety deposit vaults be contemplated they should be located and the effect on the foundations be provided for; the same for the bank vaults.

The office vaults are light and can be placed wherever convenient. The floors of these vaults should be of concrete or tile; the surface at level of the floor of the room, particularly if room floor is of wood, that the burning of the wood floor may not enter the vault. These office vaults are made the same as the partitions, either of tile or of channels and expanded metal, plastered on inside and concreted on the outside. The roof is made of T-iron, holding book tile, that is plastered on both sides. The doors are a light fireproof vault door about two feet wide with a vestibule.

ELEVATORS.

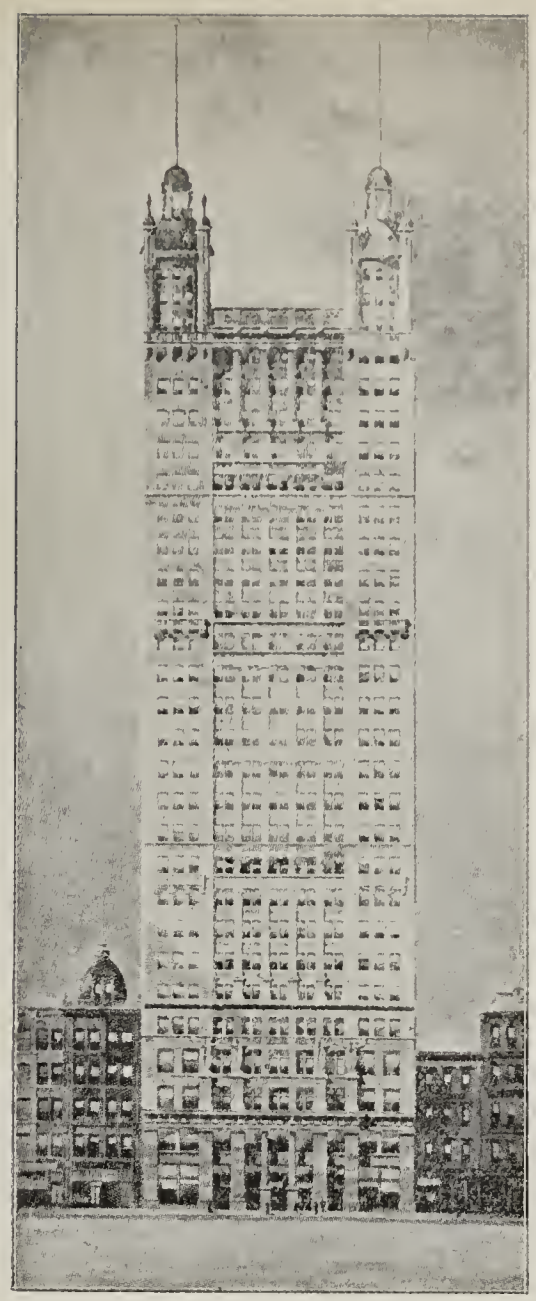
The tall buildings made the elevators an absolute necessity, and the first skeleton construction building, the Home Insurance building of Chicago, called for an elevator system such as did not exist at the time, and which was built from new patterns for this purpose by the Hale Elevator Company. Those elevators have been installed some fifteen years and are in excellent condition at present writing. They were of the vertical cylinder, hydraulic type, a cylinder shaft being constructed by the side of the elevators. Everything was so new that the Worthington pump used was soon found to be inadequate, although the selection of the pump used was left to Mr. Hale and Mr. Worthington, the owners agreeing to pay a fair price for whatever pump they should order used.

The writer, who was the architect, desired metal cars. Mr. Hale thought it impracticable to make metal cars that would not be too heavy. With the assistance of Poulson & Eger, of New York, cars were produced that were materially lighter than any wooden cars in use; in fact they were in part too light, so that they were replaced after twelve years of use, much to the regret of the writer, who was not consulted and only knew what was being done when he saw the new cars in the elevator shafts. He would have rebuilt the old original cars; being the first of their kind they had a historical interest. Since that time, when the elevators were put into the first steel skeleton building, but little change has been made in the hydraulic elevator plants. The electric elevators have made a great advance and have been greatly improved and are now coming into use. For buildings where it is economy not to run steam engines and steam pumps during the summer months, heating in the winter by the low-pressure system, electric elevators taking the current from the street are certainly desirable. They are well adapted to apartment houses and private residences, and it is now claimed that they can be advantageously used in buildings that have their own electric plant, using steam to manufacture electricity instead of pumping water.

PLASTERING.

For various reasons it is desirable to plaster with one of the hard plasters that should be mixed with sand at the factory. This will insure much greater uniformity than can be obtained

MASONIC TEMPLE, CHICAGO.
Burnham & Root, Architects.



SYNDICATE BUILDING, NEW YORK.
R. H. Robertson, Architect.

MONADNOCK BUILDING, CHICAGO.
Holabird & Roche, Architects. Burnham & Root, Architects.

EMPIRE BUILDING, NEW YORK.
Kimball & Thompson, Architects.

SOME NINETEENTH CENTURY GIANTS.

if the plasterers mix the sand with the plaster. The old method of slaking the lime at the building is difficult, as there is no convenient place for the mortar boxes. In these buildings all the trades are pushing their work as rapidly as circumstances will admit. The cost of these buildings is so large that the interest on the investment is an important expenditure. It is usual to obtain possession on May 1, or soon after, and the building must be completed by April 30 following, so that every arrangement must be made for rapid work. Mortar boxes anywhere within the building are in the way of other contractors. It seldom happens that there is any space outside the building that could be used for the mixing of mortar so that the use of the hard plaster mixed at the factory has become the rule. There is one of these plasters that requires particular notice — the so-called "Asbestic." It is composed of lime mixed with asbestos, sometimes with Portland cement added. It has the quality of resisting the effects of fire and adhering to the lathing or brickwork with a tenacity not otherwise obtained. As a nonconductor it leaves little to desire, and should be used in warehouses where an excessively hot fire is possible. By the addition of Portland cement it can be made sufficiently hard to resist the severe usage likely to obtain in a warehouse. This is particularly desirable for columns.

MARBLE TILE OR MOSAIC FLOORS.

All the halls and the public parts of the bank and the large offices should have floors of something more lasting and better adapted to hard usage than wood. A very serviceable tile floor is manufactured in Chicago. The tile are made by mixing marble chips with the best Portland cement in an iron mold. This mixture is submitted to a pressure of 2,000 pounds to the square inch. When set sufficient to handle, the tile is removed from the mold and put in a rack in a room arranged for the purpose, when it is subjected to a spray of water for thirty days. The tile is then put on the rubbing board and ground to a fine even surface. As the metal mold is made with perfect accuracy, the tiles are interchangeable and lay with exceedingly fine joints. The method of manufacture assures the greatest durability obtainable with any material other than metal.

Marble tile, usually about 12 by 24 inches, and mosaics, either of marble or ceramic, are much used. Mosaics have the objection of adhering together over considerable areas and letting go at the weakest part, causing large unsightly cracks. These are due to the shrinkage of the cement mortar in which the mosaic tesseræ are laid. The repairs, as usually made, are unsightly. This is not a necessity, for if tesseræ of proper size to fill the crack are used, and the repairs made with skill, cutting out the cracks for a considerable width, that the increased size of the new tesseræ may be very small, the repairs would not be noticeable.

ORNAMENTAL METAL-WORK.

Consisting of elevator or gallery fronts, elevator cars, exterior framework, usually for store or first story and for the second story, and for the doors of the first and second stories, and possibly to some of the large offices.

This ornamental metal-work is best of statuary bronze, certainly for the exterior. For the interior it can be either real bronze, electroplate, Bower-Barff, or painted iron, according to the price the owner is willing to pay. The designs should be artistic. Some excellent results in elevator work have been obtained in wrought iron. There is lying on the table before the writer a copy of a La France rose in wrought iron, that if the artistic critic did not praise without qualification, he would say that it was too exactly like a real rose — that it might be more conventional. Those who visited the World's Fair will doubtless remember the artistic display of wrought-iron work from Germany and from Chicago.

A metal covering for doors, window frame and sash of very good quality is now being manufactured, and is coming into use as a neat and not too expensive method of making doors and windows fireproof. If these windows are glazed with what is termed wire glass or with the Luxfer Prism metallic glazing, they are accepted by the Board of Underwriters as fireproof.

For further investigation, see

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DEVELOPMENT OF THE FIREPROOFING OF BUILDINGS.

BY PETER B. WIGHT, ARCHITECT.

THE art of building at the present day has been brought up to such a high standard of excellence that no structure can be considered to be of the best class unless every improvement that scientific investigation and experiment have developed in the direction of protecting it from the destructive effects of fire has been embodied in its construction. The use of iron as a substitute for wood for all constructive purposes was long thought to be an advance in this direction. Iron not only supplanted timber, but took the places where formerly masonry of various kinds, such as brick for piers and stone for both piers and lintels, was employed. Hence, when it was discovered that iron of all kinds was unreliable if exposed to temperatures of 900° Fahr. and over, the danger to so-called fireproof buildings, in which only an incombustible material had been so extensively introduced, was much greater than to those which had been previously erected without any regard to protection from the effects of fire. In several instances this effect was a complete collapse. The use of iron was also extended to its substitution for stone in the fronts of buildings, and the mania for this kind of architecture continued from 1855 to 1870. It was not always cheaper than stone or marble though the facility with which elaborate patterns could be produced made it possible to erect very ornamental fronts for less than the same design would cost in those materials, while if the treatment was very plain and simple the cost was greater. The main reason given for introducing this innovation was that such fronts were incombustible, and superior to stone or marble, which would chip or crack when heated and thus be destroyed as far as its monetary value was concerned, even though it did not fall. But after a few cases in which these iron fronts were affected by fire it was found that they would generally come down after slight exposure and cause a total loss.

These failures helped to call attention to the danger of using unprotected iron for all purposes. After 1870 cast-iron fronts began to be less favored, and at the same time some thoughtful investigators began to direct attention to the necessity for protecting rather than discarding the use of iron for constructive purposes. The chiefs of fire departments everywhere and some insurance authorities began to wage a warfare against constructive iron and demanded the return to wood. But they were not inventors. In course of time many inventors were at work, and though the use of protection for iron construction has been but slowly adopted, the necessity for it has been generally recognized within the last few years. So that it may be said that the inventors of fire-protecting methods for constructive iron and steel, as well as of fireproof constructions in connection with these materials, have saved from anathema and encouraged the growth of one of the greatest industries of the country.

As soon as fire protection in connection with constructive steel became an accomplished fact the improvement of both of these arts went on hand in hand, and the development of the capacity of steel for building purposes has been no less remarkable than that of the fireproofing systems used in connection

with it. The now generally used steel skeleton construction is the principal result. It is almost universally used for buildings exceeding one hundred feet in height, and there is some prospect that it may be largely adopted where the "high building" problem is not a factor to be taken into consideration. The experiment is now being tried in many places of its application to other than high buildings, and wherever it is the services of the "fireproofer" are indispensable. Its applications are multifarious, and even where it does not appear in the external walls, many buildings are being erected in which it is used throughout the interior for economy of space, and often, it is

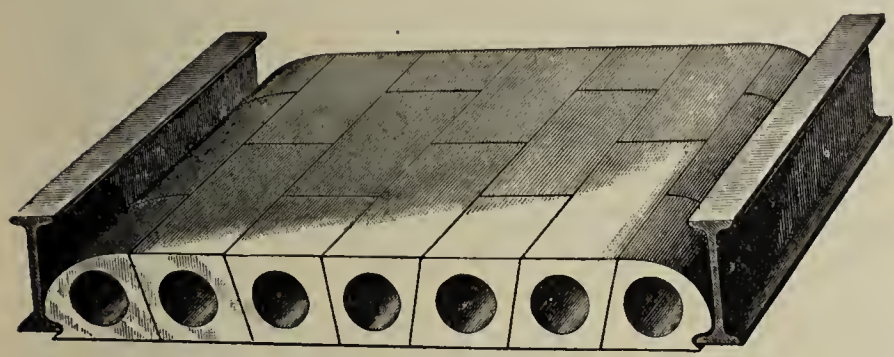

FIG. 1.

found, with economy of cost. Its influence on architectural design is not to be here considered, but will soon have to be recognized.

When iron began to take the place of wood for constructive purposes, which was in 1854, just before the cast-iron fronts were introduced, the only fire-resisting material known was the common brick, which was just what it is now, though now made by more economic methods. The only new use for bricks in those days was the construction of segment arches between the I-beams of the floors, and the idea was taken from the barrel vaults of the Romans which had continued to be used in many public buildings during the first half of this century. Then corrugated iron arches were sometimes used with concrete filling over them, which it was claimed at the time would lead to economy in dispensing with the necessity for using a centering under the brick arches and plastering their under surfaces. All sorts of devices were used for building incombustible partitions in such buildings, but no reliable method ever came into general use. It was sought to divide the buildings into rooms as far as possible with permanent brick partitions built up from the foundations, and in some cases built on extra heavy beams inserted for the purpose. These had to be provided for in the original plans of the buildings, and once built they could not be changed without great

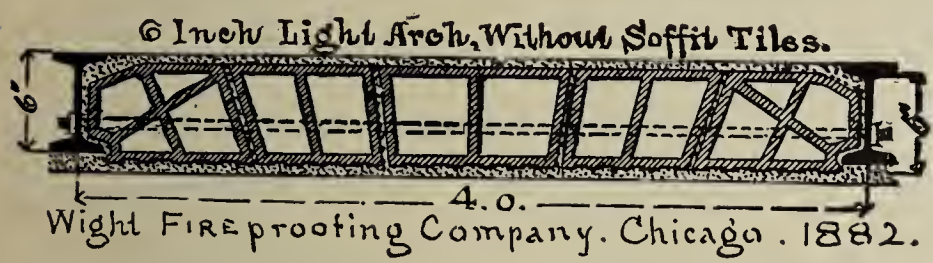

FIG. 2.

expense. The extensive use of brick partitions in such buildings was an element of safety against the extension of fire, which was to a certain extent in their favor and made them safer than if built with open construction like the modern steel skeleton buildings. This system of subdivision with brick walls being no longer used, the problem for the modern architect and the fireproofer has become thereby more complicated. But it is being solved every day by the subdivision of buildings with reliable hollow partitions.

Criticisms of the buildings which had been erected with simply incombustible construction began to be heard in 1871 after the great Chicago fire, many of which were destroyed at that time. But the alarm was heard about the same time in England, where several so-called fireproof mills and warehouses were destroyed. The first valuable improvements were made in fireproofing cast-iron columns in 1875 to 1879. This was done according to a method patented by the writer with porous terra-cotta, used in blocks, hand-made. Soon after this, in many buildings rolled iron I-beam girders were fireproofed with porous terra-cotta. The first iron roof trusses of which the individual parts were covered with porous terra-cotta are in the Board of Trade at Milwaukee. They were done about 1878. These were the beginnings of the protection of structural iron. But improvements in floor construction with a view to relieving the floors of weight were made before this time. The first use of hollow burned tiles for this purpose, in the United States, was made by the late George H. Johnson, of Chicago. They were built in one of the corridors of the New York postoffice in 1873, an illustration of which from an old circular is here given (Fig. 1). About the same time Mr. Johnson—whose son E. V. Johnson was one of the founders of the Pioneer Fireproof Construction Company, and is now secretary of the Illinois Valley Clay Company—used a similar floor construction in the Kendall building at Chicago, the Singer building at St. Louis, and several others of less note.

Shortly after this, George H. Johnson died. The contract for the fireproof work of the Chicago City Hall was one of the first in which the fireproof protection of the columns and girders was combined with a floor construction of I-beams and flat hollow tile arches. The contract was awarded in 1879.

Upon The Pioneer Fireproof Construction Company, The Wight Fireproofing Company, The Illinois Terra Cotta Lumber Company, The Illinois Valley Clay Company, and their experts, has devolved the main responsibility of building the new fireproof Chicago. It is safe to say that all the improve-

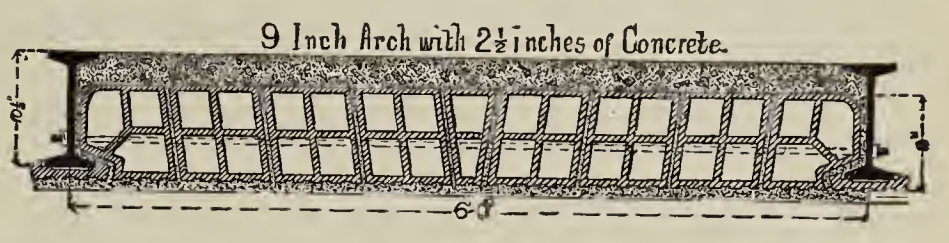

FIG. 3.

ments in the manufacture and use for fireproofing purposes of burned fire clay between 1879 and 1885 were made by the experts of the two companies first named.

The Pioneer Company had used mainly in their business hollow tiles of hard-burned fire clay, up to a year ago, when they discovered how their own clay product could be made semi-porous. Since then they have made the semi-porous body entirely. It stands between hard tile and porous terra-cotta in density, and for that reason it is not liable to crack if water is thrown on it when the material is heated to a high degree. The Wight Fireproofing Company always made a specialty of porous terra-cotta for constructive iron and steel work and hard fire-clay hollow tiles for floor arches and partitions. The Illinois Terra Cotta Lumber Company has always made and used porous terra-cotta for all purposes, the body of the material being made with a large proportion of sawdust, which is burned out in firing, leaving the material extremely light. Porous terra-cotta when made in hollow tiles combines the non-conductivity of the air spaces with the same quality in the body of the material. The Illinois Valley Clay Company uses both hard hollow tile and porous terra-cotta in its work.

The Montauk was the first high building erected exclusively for office purposes in Chicago. It was built in 1881-2, and in height is just within the limit of 130 feet now fixed by law, beyond which a building shall not go in Chicago. All the floors and roof are of hard, hollow flat arches between the 8-inch I-beams. The arches are six inches deep and made of the best fire clay, to order, and with special reference to saving weight. A section of one of these floor arches is here given (Fig. 2). The cast-iron columns and the I-beam girders

are all fireproofed with solid blocks of porous terra-cotta, the blocks being secured to the columns with iron screws tapped into their flanges, and having large washers buried one inch deep into the porous terra-cotta, as originally patented. The partitions are all built of 3½-inch hard hollow tiles. This is the first building in which railroad iron combined with concrete was ever used for the offsets in the foundations, and the first in which the walls of an adjoining building were held on screws during its erection, and the screws adjusted to its settlement. The floor arches, which weighed 25 pounds per superficial foot, were the lightest that had ever been placed in any building, and no lighter ones have ever been made since.

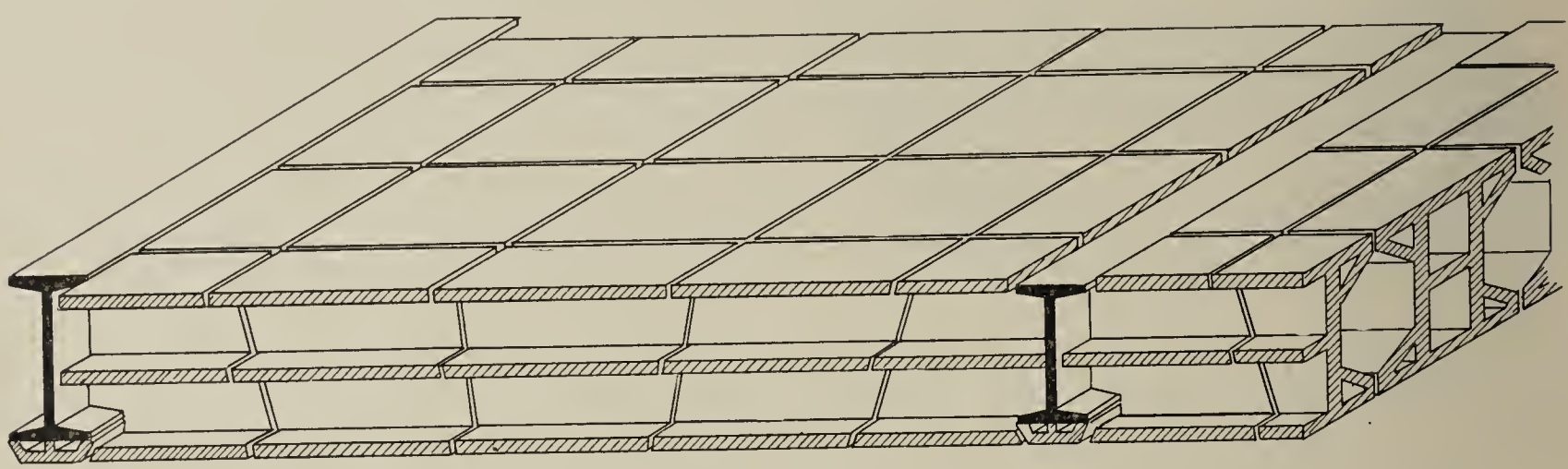

FIG. 4.

Isometrical View. Hollow Transverse System. Arch Tile.

The exterior walls and main partitions were built of brick from the foundation to the top.

Since the erection of this building all the improvements in the construction and fireproofing of high buildings have been made step by step.

In 1884 the Mutual Life Building, on Nassau street, New York, was fireproofed throughout with porous terra-cotta and hollow fire-clay tiles, by the Wight Company, of Chicago. This is the first building in which the under sides of the beams were ever covered by fire-clay tiles for the protection of the same from fire, and leaving a flush ceiling. Shortly after this, and in the same year, the beams of the Stillman Apartment House, at Cleveland, Ohio, were covered by tiles, and a flush ceiling made with tiles, by the Pioneer Company, of Chicago. Since then all the floor arches set by Chicago fireproofers have been with tile protection to the beams. The method of doing this in the Mutual Life Building is here shown (Fig. 3).

The remarkable advance made by all of these companies is now seen in the hundred or more immense buildings of Chicago and elsewhere which have been erected during the last fifteen years. These have attracted the attention not only of the architects and the public of other cities, but throughout the world, even in far-off Japan; for the drawings for the steel skeletons of a public building in that country are now being made in Chicago.

It would be impracticable in the limits of this publication to describe all that has been done and is now being done to make buildings fireproof in reality. Only a few of the latest improvements can be mentioned or described. Suffice it to say that Chicago has demonstrated to the fullest extent the great value of burned clay as a fireproofing material. But it is not alone the use of clay that makes the best buildings of the new Chicago fireproof, for not all clays are valuable for this purpose. Most of the clays can only be burned at a comparatively low temperature. If subjected to high burning they vitrify and melt. Vitrification or fusing just below the melting point is desirable for some purposes, as in the making of table ware or paving brick; but clay used for fireproofing purposes should sustain a temperature of from 2,500 to 3,000 degrees without vitrifying. It is liable to be subjected to these temperatures in burning buildings. In making hard tile the clay is used pure, with the admixture of a small portion of "grog" or refuse tile that has been ground to powder, and sometimes, but rarely, a little sand. It is burned just up to the vitrifying point. Such tile is valuable for fireproofing purposes in proportion to its toughness as opposed to its brittleness. The toughness is increased in some fire clays by the admixture of a certain proportion of shale, or clay that has been converted by natural pressure into a soft stone.

Porous terra-cotta is made by mixing sawdust with an equal bulk of clay. No high-grade fire clay can be made into porous terra-cotta, because the best fire clays are too brittle. Neither can any common clay be used, because the increased heat caused by burning out the sawdust would melt it. Hence porous terra-cotta is always made either with semi-fire clays or low-grade fire clays, which are useful for few other purposes, and which are best for this purpose; or by using common clay mixed with fire clay. The toughness is the important quality in the product. The fact that the sawdust is always burned out is a guarantee that it has been fired at a high temperature, but its strength is only imparted by the quality of material used.

Semi-porous tile is generally made by the admixture of a small quantity of ground coal. The fact that this is used is a

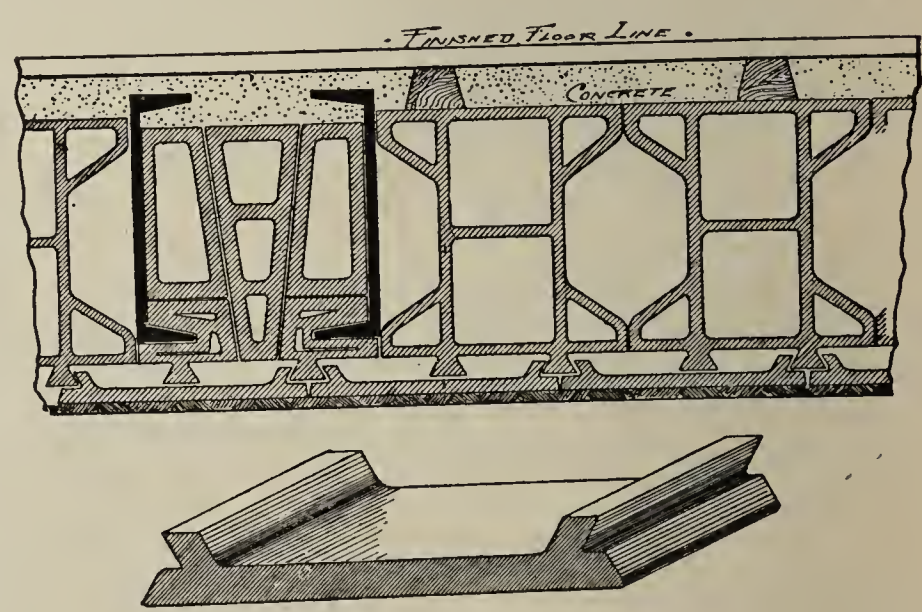

FIG. 5.

guarantee that it has sustained a higher temperature in burning than porous terra-cotta, because the coal requires a higher temperature and is more closely confined in the clay.

It was once thought by architects that most fireproofing methods were covered by patents which made them expensive, and they used to sigh for the time when clay fireproofing would become so cheap that it could be used in all buildings. This was a mistaken idea. While there were patents covering certain applications, most of the work has been done in ways that they did not apply to, and there are but few patents that have

not expired. It is safe to say that patents never increased the cost of fireproofing work, for competition between opposing patented methods has kept the prices down. The necessity for manufacturing cheaply to meet this competition, and to put the materials on the market at prices that were not prohibitory, has compelled the largest manufacturers to make their wares where the clay is found, and consequently no fireproofing material can be made for a price that will cause a demand for it

FIG. 6.

unless the clay is found and the goods are made at points where the transportation to the main points of consumption is ample and cheap. For this reason, if a manufacturer should desire to make a superior article by combining clays from distant points, as is the case with all fine table wares, it would increase the cost considerably. Whenever the ideal clay fireproofing is made so as to meet every test that the scientists may give it, it will certainly be a more expensive article than those now in general use, if clays from distant points are combined to make it.

It must be remembered, also, that each manufacturer has his own special forms and methods of construction, and that there is opportunity to discriminate between them. All can not comply with one specification exactly, and if the material were always made exactly as the architect specifies it, the cost would be increased. Hence each manufacturer is an expert in his own line, and should be regarded as such. This has always been the case west of the seaboard cities. There for many years the makers of clay fireproofing all manufactured practically the same articles, being certain stock patterns which were handled and used by the contractors in whatever way the architects specified them. In Chicago the leading men in the fireproofing business are experts. The value of their work depends upon their special forms and methods of construction, attachment and fastening.

There is only space enough herein to illustrate some of those which are most recent, and as this article is not altogether historical, a long period of improvement in floor construction must be passed over until we come to the latest developments of the art of fireproof floor construction in steel and burned clay. As showing the latest work of the Pioneer Fireproof Construction Company, Fig. 4 is introduced. This is an end-pressure arch of the simplest construction. Only one form of tile is used for the arch and one for the beam soffit. The latter is 1½ inches thick, with air space next to the beam of ¾-inch. The arch tile is cut into as many pieces as desired, the joints radiating from a common center. The skewback tiles are cut also to the section of the I-beam when the soffit is under it. The tiles are semi-porous. The latest invention of the Pioneer Company is an end-pressure arch, the underside of which is not only below the beams, but also below the girders. The soffit of the entire arch after construction is covered with loose tiles. The latter are to receive the brunt of the fire attack before it can affect the integrity of the arch itself. This system is illustrated by Fig. 5, which is a cross section of the girder and longitudinal section of the flat arch, it being understood that the beams abut against the sides of the girder, which in this case is a double channel, similar to that used in the extension of the New York Life building, Chicago. One of the movable tiles used to form the suspended ceiling is seen below the section, and we are looking at the top of it. The tiles forming the flat arches and the girder covering are run out through the die in such manner as to leave dovetail lugs on the bottom. When the work is set these lugs always come in straight lines at even distances. The ceiling tiles, which have been burned in couples, previously cut in lozenge form and then split apart after burning, are inserted between the lugs with ordinary mortar joints so as to form a continuous ceiling. This is shown in Fig. 6, which is taken from a photograph of a piece of construction of this kind that has been tested by fire, in the testing house of the Pioneer Company at Ottawa, Illinois. In this test none of the tiles were broken or displaced. Those removed in the picture are to show the bottom of the arch tiles. This system of ceiling construction was suggested by the experience of several actual fires. In many cases, while the integrity of the floor arches has been maintained, the bottoms have cracked off, necessitating the replacing of the arches to make acceptable repairs. It has also been observed in several severe fires that ceilings made of tiles that have been made in twos, and split after burning, never crack when exposed to fire and water. It was thought, therefore, that such a ceiling suspended in such a simple way below a flat, hollow-tile arch without metallic fastenings would fulfill the requirements of absolute and unfailing fireproofing. This has already been established by private tests, but it remains for

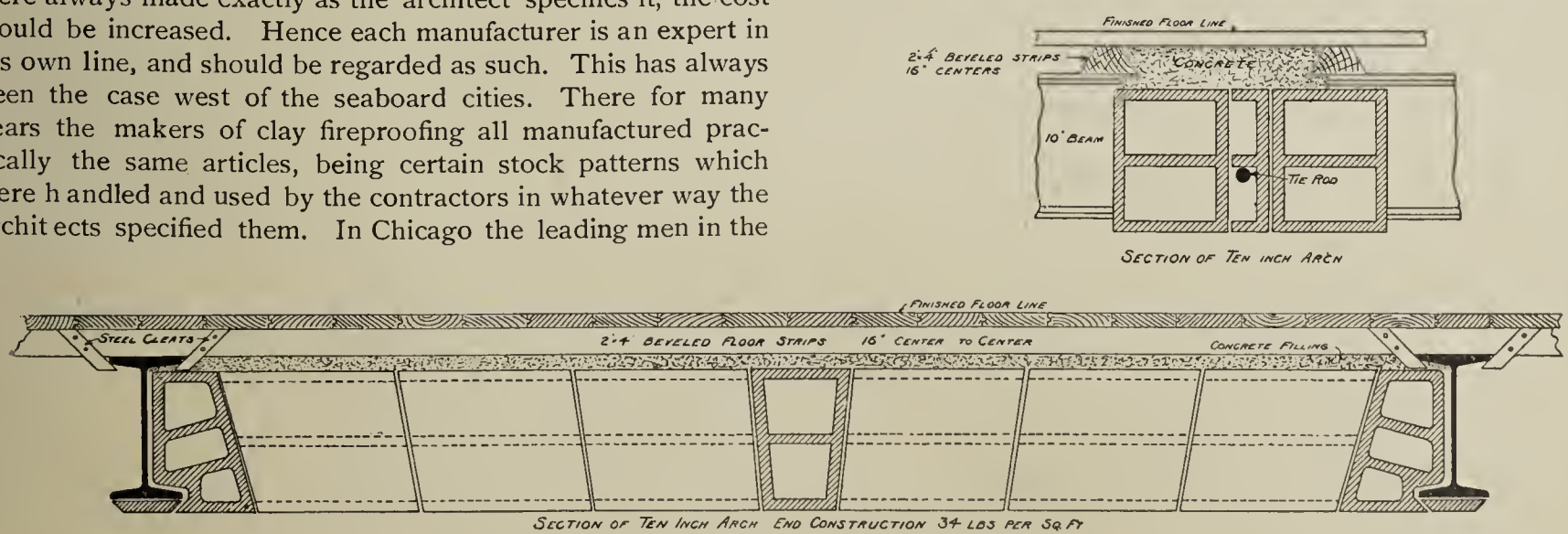

FIG. 7.

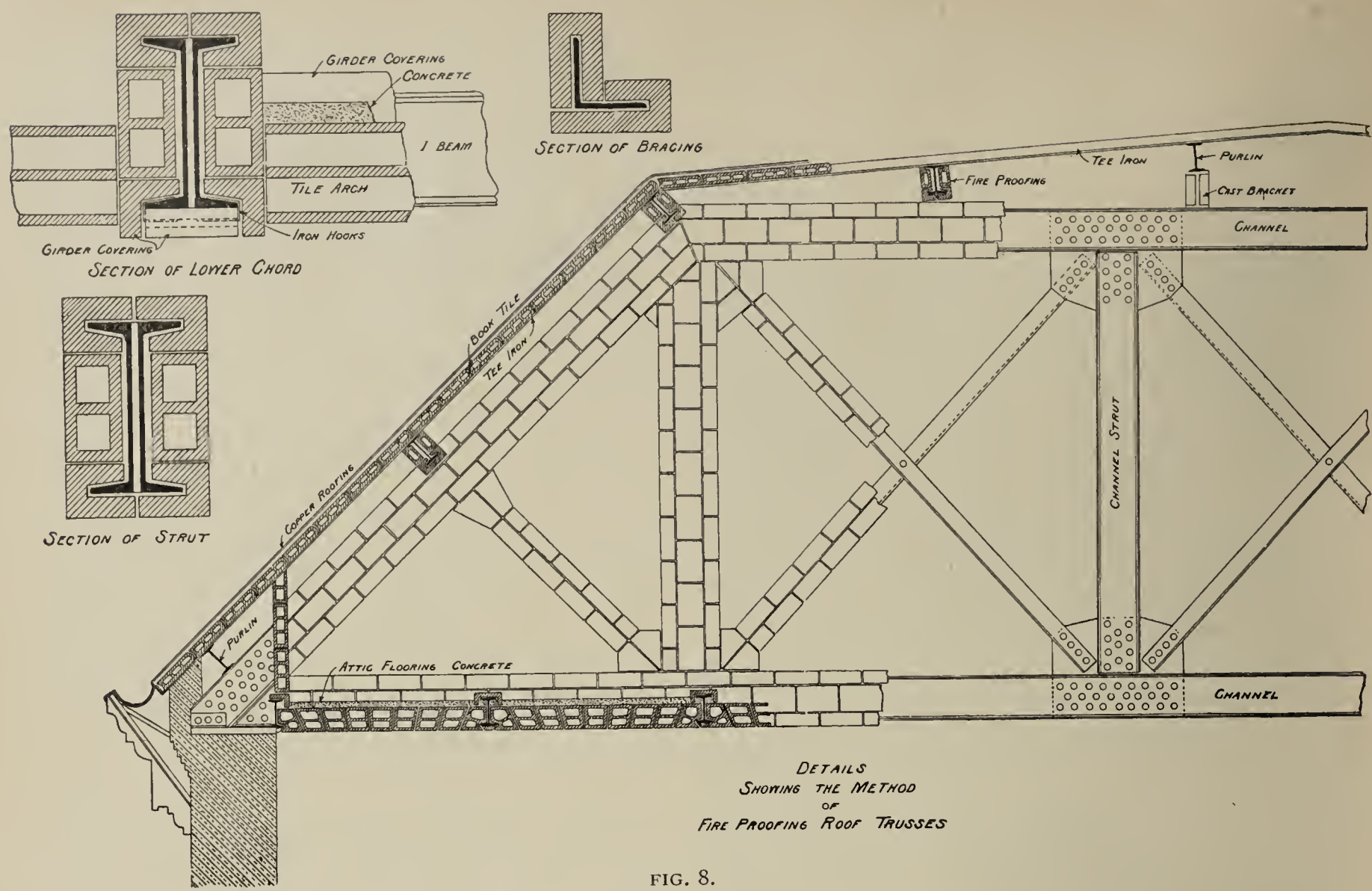

FIG. 8.

some one who is willing to pay very little extra for ideal fireproofing to put it into practice.

Two sections of the latest improved end-pressure floor arch of the Illinois Terra Cotta Lumber Company are given in Fig. 7. This is so plain as hardly to need description. As showing one of the most scientific methods of fireproofing constructive steel work with porous terra-cotta, an illustration is given (Fig. 8) which is a working drawing of a roof truss fireproofed by the Illinois Terra Cotta Lumber Company. In this the porous terra-cotta is made in such shapes that when set in cement it is self-supporting; but whenever it is necessary, as in parts subject to vibration, the tiles are bound in place by wires. These are protected by a coat of cement over the whole surface, which is applied when the tiles are wet.

For further investigation see *The Inland Architect*, Chicago, for March, April, May, June, July, 1892; June, 1893.

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HYDRAULIC CEMENTS.

BY WILLIAM S. MACHARG, C.E.

THE application of hydraulic cements in building construction has increased of late years to such an extent that its manufacture is becoming one of the great industries of the country. This increase is by no means due to its use to a larger extent in the class of work to which it was originally applied, but rather to invasion of new fields, and to the displacement of other materials.

Originally used as a binding material in stone or brick masonry in subaqueous work or in work exposed to the action of water, it has now, in many structures, displaced the former principal components, or rather combined them in a less costly, but integral form, as concrete, furnishing a monolithic mass unattainable in ordinary masonry. In common structures, in foundations and in elaborate masses the primary plasticity of concrete and its ultimate great strength, equal or superior to that of most building stones, together with its monolithic character, make it an invaluable building material.

Recent combinations of concrete with steel tie-rods, beams, and especially plate girders, have opened a new field in the covering of large areas and building permanent bridges, which it is yet hard to value. An arch of concrete is much stronger than an equal arch of brick masonry, and an arch in which steel beams bent to the curvature of the intrados are imbedded in concrete is far stronger than the first. The relative strengths have not yet been accurately determined, probably because the field is new and the materials comparatively inexpensive, but these works are rapidly increasing in number and importance, and we shall soon undoubtedly have definite determinations of the economic values.

While hydraulic cements, perhaps both natural and artificial, were used by the ancients, yet the hydraulic cement of commerce is a modern discovery, dating back less than one hundred and fifty years. In the year 1756 John Smeaton, C.E., seeking for a proper mortar to be used in rebuilding in stone masonry the Eddystone lighthouse, which had been swept away, found that the quality of setting under water possessed by hydraulic limes was due to the presence in the limestone of clay, and secured the excellent mortar used in that structure by mixing blue lias hydraulic lime from Aberthaw and pozzuolana from Civita Vecchia. It was not until 1796, however, that a true hydraulic cement appeared, when Mr. Parker, of London, took out a patent for the manufacture of what he called "Roman" cement, which was made from septaria, nodules of natural cement rock, calcined and ground to powder. Other natural cements were found in Europe, and experiments were made in the production of artificial cement, and in 1824 an English patent was granted for "Portland" cement.

In the United States cement rock was first discovered and natural cement made in 1818 near Fayetteville, New York. Other cement rocks were discovered within a comparatively short period and the manufacture was commenced of many now well-known natural cements. It is of local interest to note that cement rock was discovered at Utica, Illinois, in the year 1838, and that cement has been made at that point continuously since.

The manufacture of Portland cement was attempted about 1865 by Mr. Saylor, in the Lehigh valley, but the work for some time was experimental, and while it continued a true Portland was made to a small extent at Kalamazoo, Michigan, in 1872. The growth of the industry was slow in the United States, as is shown in the following table made from official figures given by Mr. Robert W. Lesley, in the *Journal of the Franklin Institute*, November, 1898, of the amount and origin of the Portland cement used in this country, years showing marked change in domestic being selected :

	American.	Foreign.	Total.
	Barrels.	Barrels.	Barrels.
1882	85,000	370,400	455,400
1885	150,000	554,396	704,396
1887	250,000	1,514,095	1,764,095
1892	547,440	2,440,654	2,981,094
1894	789,757	2,638,107	3,427,864
1896	1,543,023	2,989,597	4,532,620

From another source the figures for last year are taken, the quantity imported being approximate :

	American.	Foreign.	Total.
1898	3,698,248	2,000,000	5,698,248 bbls.

During the year 1898 there was also manufactured in the United States 8,276,424 barrels of natural cement.

While the manufacture of American Portland cement has increased so rapidly during the last few years as to shut out foreign cements largely except in seaboard cities, the demand has been such that derangement in transportation facilities has often produced local shortages of supply. As a result many new mills are being erected throughout the country.

The past twenty-five years has seen a great improvement in the quality of Portland cement, due in part to the use of better machinery, and in part to the exercise of greater care in the selection and proportionment of materials, and these improvements have been brought about principally by the general and systematic examination and testing of the cements offered in the market. Cement testing has been made easy by the provision of special apparatus of little cost, and it is unusual now for any work using a considerable amount of cement to be carried on without continuous testing of the cement offered. A new class of mechanics has therefore come into existence known as cement testers. The term mechanics is used advisedly and without any invidious meaning. The manual and operative process of cement testing is purely mechanical, and attempts have been made to secure uniform results by regulating and fixing the steps in the process, and even by the introduction of machinery in the preparation of the test pieces. Uniformity is to some extent desirable, and yet this desirability is limited. As a building material hydraulic cement differs from all others, except lime, in this great and essential feature, that it is an unfinished product; that is, that after introduction into the structure it proceeds to its final office and state. This condition, together with allowable variation in its composition, renders the tests which are made to establish the quality of the unfinished material indicative tests and not proof tests.

Fortunately the large laboratories where cements are tested are in the control of persons qualified to pass judgment on these indicative tests, but there exists a danger in the common system of general testing which may bring serious injury upon the cement industry in this country. Taken in conjunction with the ordinary American desire for improvement, and the wish or necessity for quick returns on investments, mere mechanical testing—assuming that if certain qualities approved by tradition are good, the same qualities exhibited in a higher degree are better—may result in the production of a material which will eventually wreck many a well-planned structure.

The chemistry of hydraulic cements, both in the requirements of manufacture and in the final process of setting, are by no means agreed upon even by the eminent men who are making it their life study. Michaelis, Le Chatelier, and Newberry, with others, are gradually evolving a firm basis upon which manufacture may proceed with more certainty, but at the present time the only absolute proof test of an hydraulic cement is *time*.

It is in Portland cements that the danger spoken of is chiefly to be feared. Competition is fierce, and as the material is purely artificial, some added material being necessary even in the rock Portlands to secure correct proportions, demands by the consumer, even when not based on correct judgment, will be met by the manufacturer.

It must be borne in mind that the manufacture and use of Portland cement dates back only seventy-five years, and for a good many years its use was attended with many failures. Thirty years ago careful and judicious American engineers did not care to trust Portland cement concrete in important foundations or heavy structures. It was through the careful and intelligent work of Grant and Faija, largely, that English manufacturers were brought to recognize the need of care and exactness, and that certain brands of English Portland cement acquired a reputation for stability and other good qualities. A great impetus was given to the use of concrete by the building of Port Said, where this material was used exclusively ; the binder, however, in the Port Said concrete was a natural product, the hydraulic lime of Teil. About this time the Germans entered upon the manufacture of Portland cement with their usual methodical care, and produced good material. As a consequence of all these conditions, concrete has advanced rapidly as a building material.

From the early successes and failures of Portland cement in mortars and concretes certain deductions were made which have become traditions, and, as in most traditions, the origin has become obscured. One of these traditions is that the slowest setting Portland cements are the best, and the class of testers above referred to accept this maxim without limitation, apparently without knowledge of its origin. The early users of Portland cement found from experience that cements which commenced setting very quickly, or which acquired a very great strength in a short time, say a week or less, were likely to "go back" or retrograde, and that this might even proceed to disintegration in time. They also noted that these qualities — that is, quick commencement of set and rapid continuance to great hardness — were apt to be combined in the same cement ; hence the deduction. These conditions, singly or united, were an indication that either in proportioning the components or in the processes involved, something was wrong, and the cement likely to be unsafe.

At the present day, under the pressure of competition and under the warrant of testers, the early strength of cements is being gradually forced up, and the time of the apparent occurrence of initial set is being retarded by the admixture of gypsum. Why should the addition of two per cent of gypsum change the inherent qualities of a cement which would have been rejected thirty years ago on its abnormal strength at the age of seven days? What significance has the artificial delay of the initial set for two or three hours? If time is the only proof test of works in Portland cement, why should changes in method which may be vital be allowed to, or rather forced upon, manufacturers upon the sole warrant of mechanical laboratory tests?

There has been a considerable legitimate improvement in Portland cements within the past thirty years, and credit must be given for it to careful, intelligent study in laboratories, but there must be a distinction made between this study and the common inspection tests made upon work, and the influence of

AT MILWAUKEE.
Ferry & Clas, Architects.

AT BOSTON.
McKim, Mead & White, Architects.

AT CHICAGO.
Shepley, Rutan & Coolidge, Architects.

AT WASHINGTON.
Smithmeyer & Pelz, Paul J. Pelz, Edward P. Casey, Architects.

NOTEWORTHY LIBRARY BUILDINGS.

the latter upon manufacturers must be limited. Such limitation can only come from intelligent supervision, and it is upon architects and engineers that this responsibility rests.

The value of different qualities in Portland cement depends entirely upon how or where it is to be used. For instance, the extreme hardness attained by some cements in a short time is only valuable where the work is to be quickly exposed to abrasion. A driveway or walk is an example of such work, and this is easily and at small expense replaced if anything is wrong with the cement. In the case of footings in a large building, or foundations for heavy machinery, however, the cost of renewal includes vast expenses, and the original conditions do not require an extraordinary degree of strength or hardness in the cementing material, therefore stability should be the quality particularly sought, and indications possibly inimical to this quality should be given great weight in the selection of material. Engineers are beginning to realize this danger, and some recent specifications contain a limiting maximum strength at seven days which is much below that set forth as desirable in many American Portland cements.

CEMENT NOTES.

Of American Portland cement works, the Atlas plant is the largest, turning out in the neighborhood of 4,000 barrels a day. This cement is well known and highly appreciated; it was used in so far as it could be obtained in the construction of the heavy concrete work involved in the track elevation at Clark and Sixteenth streets, Chicago.

The Alpha plant is also very large, turning out about 3,000 barrels a day. This cement was one of the earliest of the Lehigh valley cements to come into the Chicago market, and has been used extensively, one of the largest works being the retaining walls for track elevation of the Lake Shore & Michigan Southern Railway at Sixty-third street, Chicago.

Giant cement, also from the Lehigh valley, is being used in the construction of the main conduit of the southern intercepting sewer system, on Thirty-ninth street, Chicago. This conduit is of horseshoe form, the horizontal diameter being twenty-two feet, and the lower section is of concrete.

The beautiful bridge lately built in Garfield Park, in this city, is of a type that will have an extensive use for permanent bridges. The type admits a combination of good design and great strength, being of steel beams imbedded in a monolith of concrete. In this bridge, Vulcanite cement was used, and the careful execution of the work has produced a fine example of this class of structures.

Among the natural cements there is none which has a higher reputation in the Western markets than Utica cement. This was first made over fifty years ago for use in building the Illinois and Michigan canal, and it has been used continuously since that time in all the public works of this city, and these bear witness to the value of this cement.

The use of concrete in floor construction in heavy fireproof structures is very common, but the heaviest concrete floor construction in this country is said to be that of the Gottfried Brewing Company's stable building, the average dimensions of the arches being 10 by 14 feet and 3 feet thick at the beam. In order to bring the weight of the arch upon the beams before the cement had fully set, in this instance a system of suspended centering was designed and patented, which has come into extensive use since, owing to its great convenience. Iron hangers acting on the principle of ice tongs, one end provided with jaws to clutch the lower flange of the beam, and the other end of each piece bent into a step to carry a joist, are set at proper intervals on the beams; the joists are set in position, carrying the sections of centering, which are thus forced up tightly against the bottom flanges of the beams from which they are hung, and as the concrete is rammed in place the weight is brought upon the beams. The centers are easily struck by disengaging the hangers, and the apparatus is exceedingly convenient for use.

A novel use for concrete is in the construction of tanks for boiling purposes. A set of three connected tanks, each 20 by 16 by 6 feet inside dimensions, has been built as a monolith for the Chicago Veneering Company, for the purpose of boiling large logs in their process of manufacture. Near the bottom in each section is a concrete shelf which protects the perforated steam pipe, which is run in the tank below the shelf, from injury by the logs as they are dumped into the tanks.

For further investigation, see

Mortar: Cost and Strength, Rep. Chf. Engrs. U. S. A., 1893, Vol. IV. Tests, Rep. Chf. Engrs. U. S. A., 1893, Vol. IV. Economics of Cement Mortars, *Eng. News*, Aug. 10, 1893. Effect of Frost on Green Masonry, *Eng. News*, March 26, 1894; Trans. Can. Soc. C. E., Jan.-June, 1894; *Eng. News*, May 2, 1895; Trans. Assn. of Civil Eng'rs of Cornell Univ., 1893. With Salt Water in Winter, *Inland Arch.*, Vol. XI, p. 55. Mortars and Concretes, *Inland Arch.*, Vol. XII, p. 35. Tests of Cement Beams, *Inland Arch.*, Vol. XXVIII, p. 16.

CLAY MATERIAL AS USED IN THE BEST MODERN BUILDINGS.

BY WILLIAM D. GATES.

BURNED clay has come into plentiful use in modern building construction and has come to stay. From the very fact of its plentitude, efficiency and adaptability, it has won its place in the art of modern building with a rapidity and scope that have been surprising. This is not to be wondered at when one considers the versatility of the American and the adaptability of the material to the uses. Modern requirements, combined with the trying conditions of a climate in which the tearing-down effects of ceaseless change are constantly at work, demand their use. Torrid heat is quickly succeeded by arctic cold, and rain by sleet, and sleet by snow, and all the trying, prying effects of zero, ice and storms, strain and wear and tear at the structure. Not only must the material withstand these

Executed in Terra-cotta by Northwestern T. C. Co.
Adler & Sullivan, Architects.

forces, but it must protect what is within, must be an insulator of cold and heat, must resist cold and damp, must be strong and lasting, must be pleasant to the eye, must be beautiful in form and color, and must combine with all these many requirements the one great essential of cheapness.

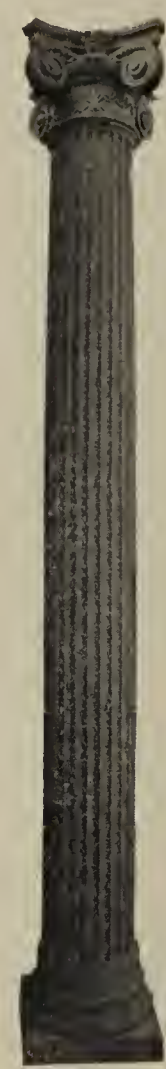
All the cunning of all the earnest workers, in all the scattered brickyards of the country, has been strained and turned toward the betterment of their product in shape, texture, color and cheapened production, until wonderful results have been produced and it would seem that perfection were well nigh at hand. They have done more to bring color within the reach of the architect, for use in the construction of durable exteriors, than almost any one in the material field, bringing in, as

they have, all the solid tints in reds, pinks, buffs, grays and browns, as well as all the wealths of tint in fire flashes and speckles. They have studied their department of the art — for clay working is an art indeed — thoroughly and consistently, with all the zeal that belongs to a devotee (and workers in this art are devotees). They are, in fine, believers in their work. They believe that they have the best material for the work to be accomplished, and they labor earnestly and faithfully to mix into their wares the one very essential ingredient, which must always be mixed with crude clay to make a good product — brains. Having such faith in their material and understanding the field that is to be filled, they stop at no obstacle and brook no hindrance, but struggle through the multitude of trials and disappointments that await them, for trouble is closely connected with clay. Disappointments are many and experimental work is long drawn out. Mixtures must be made and weeks

Terra-cotta trimmings, at Hartford, Connecticut.
Peabody & Stearns, Architects.

afterward results must be studied after the fires have done their work.

Other devotees than Pallisy have burned furniture, in one way or another, and others than he succeed to their reward after surmounting difficulties and hardships. This, not of the brickmaker alone, but of all clayworkers as showing that the finished structure is beautiful and durable, not only through the good qualities of the crude clay, but also by means of the brain and energy of the faithful worker, who wrought something of his life itself into the material and made it possess something of his own individuality. Of course, the architect looks ahead and studies the needs, and schemes out a way to meet these new and very pressing requirements. Land has become very valuable and two or three floors will not do, but the building must extend skyward. This would be well-nigh impossible, following old methods, for the lower stories would be well-nigh solid with masonry and the weight excessive even then. So he plans the use of other wares, and calls on the disciples of Vulcan to build him a bridge on end, to protect and ornament which he summons the clayworker, sees what he already has and counsels him as to what he further requires as to shape, color or other effect. Then, too, he uses the individuality of the builder and brings in effects such as Flemish bond or special shape effects. So that in the end the well-burned



Terra-cotta shaft, one piece, 8 feet long.
Executed by American T. C. Co.

clay shuts out the storm and protects the skeleton of steel that upholds the building, and thus conserves space, beautifies the structure and shelters the occupants as well from the elements. All a man's treasures are confided to its care. His dearest treasures, his family, rest sheltered by it in a quiet, protected home, while his fortune he puts into a protecting vault, held secure from fire and theft by the brickmaker's work.

Time was and that too but recently, when he who wished to use enameled brick must send to far-off countries, and when he who wanted enameled terra-cotta must go without, but now our own manufacturers are proud of the quality, texture and tint of the wares they produce here. Their wares have been speedily utilized by the architect and the builder as being an ideally

Executed in terra-cotta.

cleanly ware for our dirty cities, as being among the few wares unaffected by the tearing and wearing forces of a great city and as among the extremely few that could be easily cleaned from the city's dirty grime. It has been extensively utilized for the white purity of the bath, the cleanliness of the kitchen, the

light-giving walls of the court, and now and again for the front of some building where the despairing owner desired cleanliness, and even, on occasion, owner and architect have been daring enough to court criticism by using color.

The maker of roofing tile has been active and zealous in his department. He has found new requirements and has risen to them with new shapes, new designs, new color effects and improved weather-resisting bodies and wares.

But into the field of the manufacturers of terra-cotta there come problems unknown and undreamed of by other craftsmen. Others have stock and sort to color, while he is called on to match any and all colors, in pieces in all sorts of shapes for all sorts of individual places, every one of which must match the sample in color and fill its allotted space and mission in the

Executed in terra-cotta. Holabird & Roche, Architects.

building. He must so know his mixtures and shrinkage that he can calculate ahead as to what these will be when they have passed through the heat. He must spend money and energy freely — unstintingly — in thousands upon thousands of experiments, of all of which he must keep accurate account, so that he can duplicate any one accurately, and thereby stand ready at the call of the architect. In this, however, he has the reward of an interesting line of work and a work that keeps him tense and on "concert pitch" all the time, allowing him no time for rest, but constantly urging him on to other triumphs.

Then, too, when his work is done; when the building is complete and the bill paid, he can always glory — with the architect — in the building, and stand straighter and feel bigger when he looks at his own honest ware protecting and beautifying the building.

Other articles are:

Brick Work, *Inland Arch.*, Vol. VII., p. 58. Terra-Cotta, *Inland Arch.*, Vol. VII, p. 97. Repg. T. C., *Inland Arch.*, Vol. XVII, p. 59.

ELECTRICAL ENGINEERING FOR ARCHITECTS.

BY ARTHUR VAUGHAN ABBOTT, C.E.

THE development of the applications of electricity during the past twenty years has produced a new set of problems to be solved by every architect in the construction of such buildings as are placed under his charge. A generation ago, no question arose as to the methods of illumination. A set of gas pipes was introduced, connected to the municipal supply; the various rooms were equipped with chandeliers, and the work was done, giving the architect little or no opportunity either from a mechanical or an esthetic standpoint. The advent of the electric light, however, changed all this, and at present it is essential that every building of magnitude shall be not only supplied with illuminating gas, but, in addition, electricity as an illuminant must be introduced, and in connection therewith all of the electro-mechanical problems necessary to the safe and proper installation of the new agent must be considered.

With the esthetic features the present paper has little to do, and is restricted to a consideration of the proper manner of introducing electricity, the uses to which it may be applied, and the safeguards which should be observed in its installation.

In the early days of electric illumination each building had to be supplied with a separate and independent plant for the generation of the necessary electrical energy. Soon, the idea of central station supply became current, and rapidly the larger cities were equipped with generating plants of magnitude, and the principal streets furnished with distributing mains, so that architects were no longer required to provide isolated plants. The illuminating companies took great pains to inculcate the idea that it was much cheaper to buy electricity than to install and operate an isolated plant, and in the majority of cases this statement has been and is still correct. Yet of late there has been a considerable tendency on the part of larger stores and other buildings to install plants and to supply themselves with electricity under their own management, and therefore the first problem to be solved is to determine whether an isolated plant shall be used or not.

This question is purely an economic one, namely, Will the operation of an isolated plant be cheaper than the purchase of a sufficient amount of electricity from the central station? To reply correctly, it is necessary to approximate the load line of the building; to determine therefrom the maximum demands to which the plant must respond, and the load factor which is likely to be obtained. Both of these points are essential. For the capital necessary to invest in the isolated plants depends on its size, and this is in direct proportion to the maximum demand, while the expense of operation is governed by the average load factor.

To determine the probable load line it is convenient to plot, upon transparent cross-section paper, the estimated amount of electricity required to supply the demands of the building for, say, the months of June, December, April and September. Then, by superimposing the four drawings, the maximum demand can at once be read, and the average load line calculated with a planimeter, from which it is easy to ascertain the load factor. Such a diagram is shown in Fig. 1, taken from a large hotel plant.

For office buildings, an approximate estimate may be made by assuming that about seventy per cent of the connected lamps will be illuminated during December from 4 P.M. to 6 P.M., about fifty per cent will be used from 8 A.M. to 9 A.M., and in addition all of the lamps in covered corridors, toilet rooms and dark inside rooms will burn continuously from 7 A.M. to 7 P.M. After 6 P.M. not over ten per cent of the connected lamps will, on the average, be used for about three hours during the evening. For September and April, about fifty per cent of the connected lamps will be used from 5 P.M. to 6 P.M., while lamps in halls and dark rooms will burn as before, possibly ten per cent will be used for an hour in the morning. For the June diagram, not more than ten per cent of the connected lamps will be used from 6 to 9 P.M. No lamps will be lighted in the morning, and those in halls and dark places reduced one-half. About the same rule may on the average be held to apply to the larger stores that do not remain open in the evenings. For hotels, clubhouses and similar buildings, about eighty per cent of the connected lamps will be expected to burn from 4 to 8:30 P.M. in December, about sixty per cent from 8:30 to 10 P.M., and about forty per cent will be used from 10 to 11 P.M., while about forty per cent must be expected to be in service from 6:30 to 8:30 A.M. In April and September about the same percentages of lamps will be used, but the hours of lighting will not commence before 5 P.M. and will end at 8 A.M. In addition, the necessary lights for halls, corridors, etc., must be included.

The power demands may be calculated in a similar manner. For the ordinary office building, electric elevators and electric

pumps for house water supply are now common pieces of machinery whose use is rapidly extending. For the pumps, a steady load line may be assumed where it is practical to so design the pumping machinery that it may operate at a uniform load from 8 A.M. to 5 P.M. The elevator load will be a maximum between 8 A.M. and 10 A.M., 11 A.M. and 2 P.M., and 4 P.M. and 6 P.M., while for the rest of the time about forty per cent of the elevator capacity should be allowed during the day time and about five per cent during the evening from 7 P.M. to 10 P.M. In summer, from June to October, the load imposed by fan motors may amount to a considerable item, averaging about twenty-five per cent of the connected lamps. In office buildings, excepting in special cases, there is little other demand for power; but in hotels, clubhouses and the like, considerable additional power must be allowed to operate kitchen and laundry machinery.

Having from this or similar data plotted the load line for the plant in question, the maximum demand can at once be read from the diagram, and the average load factor calculated by determining the ratio between average demand for power and the maximum capacity of the plant. The architect is now ready to select the appropriate machinery to meet the demands of the building. For economical operation the plant should run uniformly under such a load as will give the least steam consumption per unit of output, but as the load diagram shows a very wide range in demand it is either necessary to secure a large degree of flexibility, or else to operate uneconomically during the greater portion of the time. There are two methods which may be employed.

First: The necessary capacity may be secured by arranging several generating units of medium size, which may be operated either singly or in parallel, and by starting or stopping one or more of these units, the demands on the plant may be met by the most economical rate of supply.

Second: A generating plant may be designed of such size, that its entire output during a given twenty-four hours shall equal the requirements of the building. Such a plant will deliver too much electricity during the hours of light load and too little during the hours of heavy load; but if it be run in connection with a storage battery, to absorb energy during the hours of light load and to emit this energy during the hours of heavy load, the requirements are provided for. Theoretically this method is ideal, and were storage batteries in practice as successful and economical as they are in theory, there would be but little question as to the advisability of their uniform adoption. Unfortunately, particularly in this country, accumulators have not at present arrived at that degree of perfection which electricians have always hoped and even claimed for them, so it is impossible at present to give a hard and fast rule which shall govern a decision between the multiple unit generating plant *vs.* the storage battery. For each particular case the question may be determined by comparing the cost of operating the multiple unit plant with that of the battery plant, augmented, however, by the interest and depreciation necessary to allow on the capital invested in the battery, which should be taken at not less than eighteen per cent per annum on the cost of the cells.

Having determined the proper size and kind of plant to install, and estimated the cost thereof, it is next advisable to determine the expense of electricity, as made up of the cost of operating the plant plus the interest and depreciation of the capital invested therein.

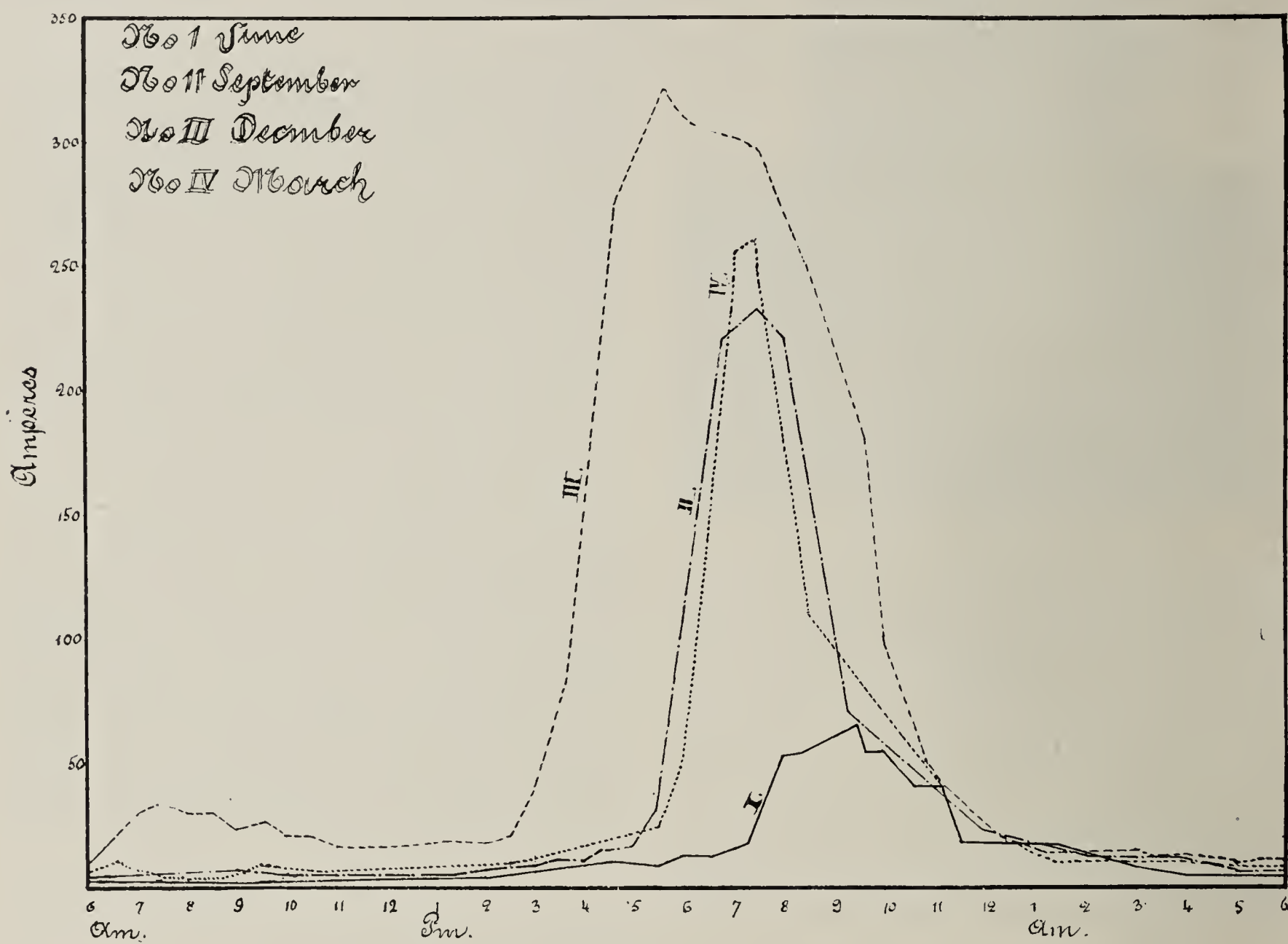


FIG. I.— HOURS.

With ordinary coal at $2 per ton and a well built, carefully managed plant, it should be easy to produce steam at an expense not to exceed 12 cents per 1,000 pounds. With varying prices of coal the expense of steam raising will be closely in direct proportion to the change in fuel prices.

With average engines a steam consumption of from 28 to 32 pounds per horse-power for simple engines or from 20 to 25 pounds per horse-power for compound engines should be allowed. Under average loading the generator efficiency for direct-connected machines will be from eighty-five to ninety per cent; thus this data will enable the designer to determine, for each case, the cost per kilowatt hour of current delivered at the generators, and to compare the same with the selling price of current as delivered by the central station supply, and whichever then shows the most favorable figures is the proper method to advise.

Generally stated, for all ordinary office buildings and stores, it is cheaper and more reliable to depend upon the central station than to install an isolated plant, *provided* the boilers must

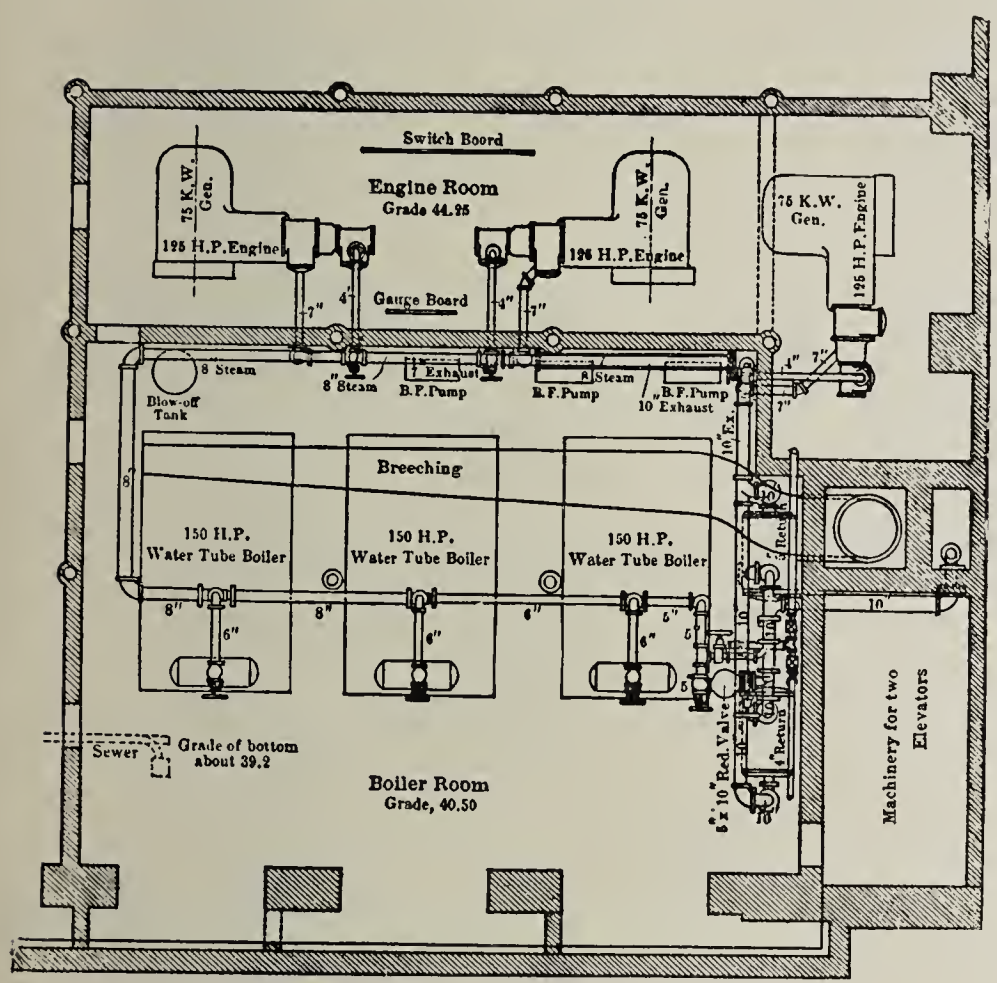


FIG. 2.—PLAN OF BOILER AND ENGINE ROOM.

be continuously used to supply the electric plant only, but it is now usually necessary to supply office buildings with a boiler plant for steam heating, which in ordinary northern altitudes must be operated for at least eight months during the year for this purpose. If, during the average heating season, the steam required for heating is greater than that needed to supply the other machinery in the building, such as elevators, etc., plus the necessary steam required to operate the electric plant, then it is obvious that as steam for heating may first be passed through the engine cylinders without detracting from its heating efficiency, all the building machinery may be supplied with steam during the heating season at no greater cost than is required to warm the building, and should only be charged with fuel expense during such part of the year as steam for warming is not required. Under this condition, an isolated plant may be very profitable and the designer need pay little attention to steam economy, for as more steam is required for heating than is sufficient to operate the various steam cylinders, compound or condensing engines and back pressure upon the pistons are matters of but little importance.

In very general terms the prices charged by central stations for electricity for lighting vary from .8 cents to 2 cents per 16 candle-power lamp hour. For power the rates vary from 5 to 10 cents per kilowatt hour, depending upon the quantity used. The cost of producing electricity by isolated plants, including interest, depreciation and insurance, with coal at $2.50 per ton and labor at $3 a day, will vary from 6 cents per kilowatt hour, with

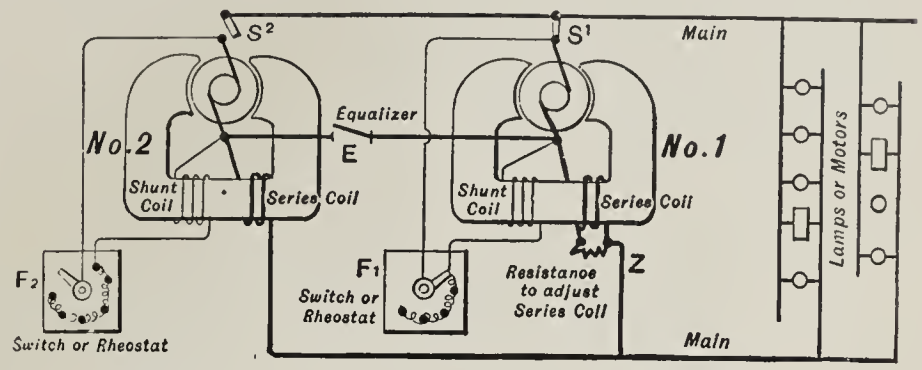


FIG. 4.—COMPOUND-WOUND DYNAMOS IN PARALLEL.

an output of say 50,000 kilowatt hours per annum, to 3 cents per kilowatt hour for an output of 500,000 kilowatt hours per annum.

Generating Plant.—Assuming that the comparison between the cost of producing electricity by an isolated plant and that of a supply from the central station indicates the advisability of an independent installation, the designer must provide the best and most economical machinery for the purpose. A general design for such a plant is given in Fig. 2. It is convenient, therefore, to divide the plant into four parts: The Steam Plant, the Engines, the Generators and the Switchboard. All this machinery is now so completely elaborated by first-class manufacturers that it is unnecessary for the designer to prepare anything more than a general specification and to award the contract to the lowest responsible bidder among the well known builders of the various classes required.

Boiler Plant.—Where steam pressure of sufficient magnitude to operate modern engines is required, it is inexpedient to consider anything but one of the best-known forms of water-tube boiler. Though this type is more expensive in initial cost, its greater safety, decreased cost of maintenance, facility of repairs and ease of installation, make its selection advisable where steam pressure of 80 pounds or more is to be carried. In plants requiring 300 horse-power or over, it is desirable to provide one of the standard forms of automatic stokers, as it is uneconomical to require one fireman to attend to and handle coal for a larger boiler capacity, and wherever the saving of a man's labor can be made mechanical appliances will invariably show a profit.

Careful attention should also be paid to securing the best

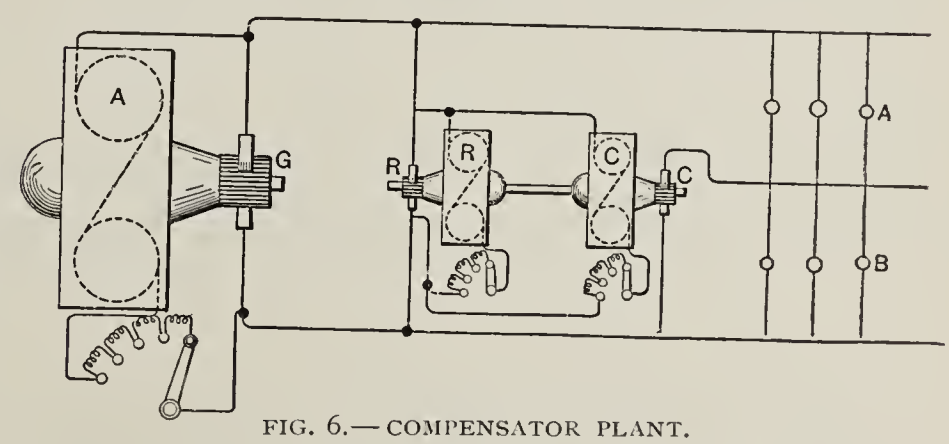


FIG. 6.—COMPENSATOR PLANT.

facilities for handling coal and ashes. Storage for at least sufficient fuel for a week's run should be provided, to guard against strikes, snow blockades and other contingencies, which, if the reserve were small, might necessitate a shut-down of the plant. If possible, the coal and ash bins should be so located, with reference to the boilers, that the fuel may run by gravity to the stokers, and when the ash pits are cleaned the

refuse should pass by its own weight to the ash bins, thus allowing the fireman to give all his attention to the boilers by relieving him as far as practicable from manual work. Where the arrangement of the building is such as to render this plan impracticable, a light railway or overhead telegraph with automatic buckets is the best substitute. Proper scales should be provided, in order that all coal and ashes may be weighed, for in no other way is it practicable to keep a check upon the performance of the boiler plant.

By placing a pump upon the end of the heating system the radiators, at least during the winter season, may serve as an air condenser, and the steam consumption of the engines thereby somewhat reduced. The discharge of this pump should feed the boilers through a heater, even if live steam be used for the purpose, for although apparently paradoxical, it is cheaper to use live steam to heat the feed-water rather than to feed it cold to a hot boiler. All the boiler feeds should also be carefully metered and checked against the coal consumption.

Engine Plant. — The engines and generators should always be direct-connected machines, as belt-driven apparatus is a relic of a barbaric electrical past. It is also desirable to secure as heavy and stocky an engine as can be procured, even at some additional cost, for with the unexpected loads to which an electric light plant is frequently subjected, cast iron is very much cheaper than a break-down, and generous and ample proportions in the bed plates and frames is good engineering. The reader will at once debate the advisability of multiple expansion engines over those of the ordinary simple type. It has already been shown that an isolated plant, operated solely for the production of electricity, can rarely pay in competition with the central station supply, and that such plants are usually profitable only in connection with some other demand for steam. If, therefore, heating buildings or other requirements necessitate a steam supply for a greater portion of the year, the advantage both of the compound and condensing engine largely disappears and it is of little or no consequence to incur additional expense in the plant, solely for the purpose of steam economy. Indeed, from some points of view, there may be a distinct disadvantage in the multiple expansion engine, for, though less steam per horse-power is consumed, the increased

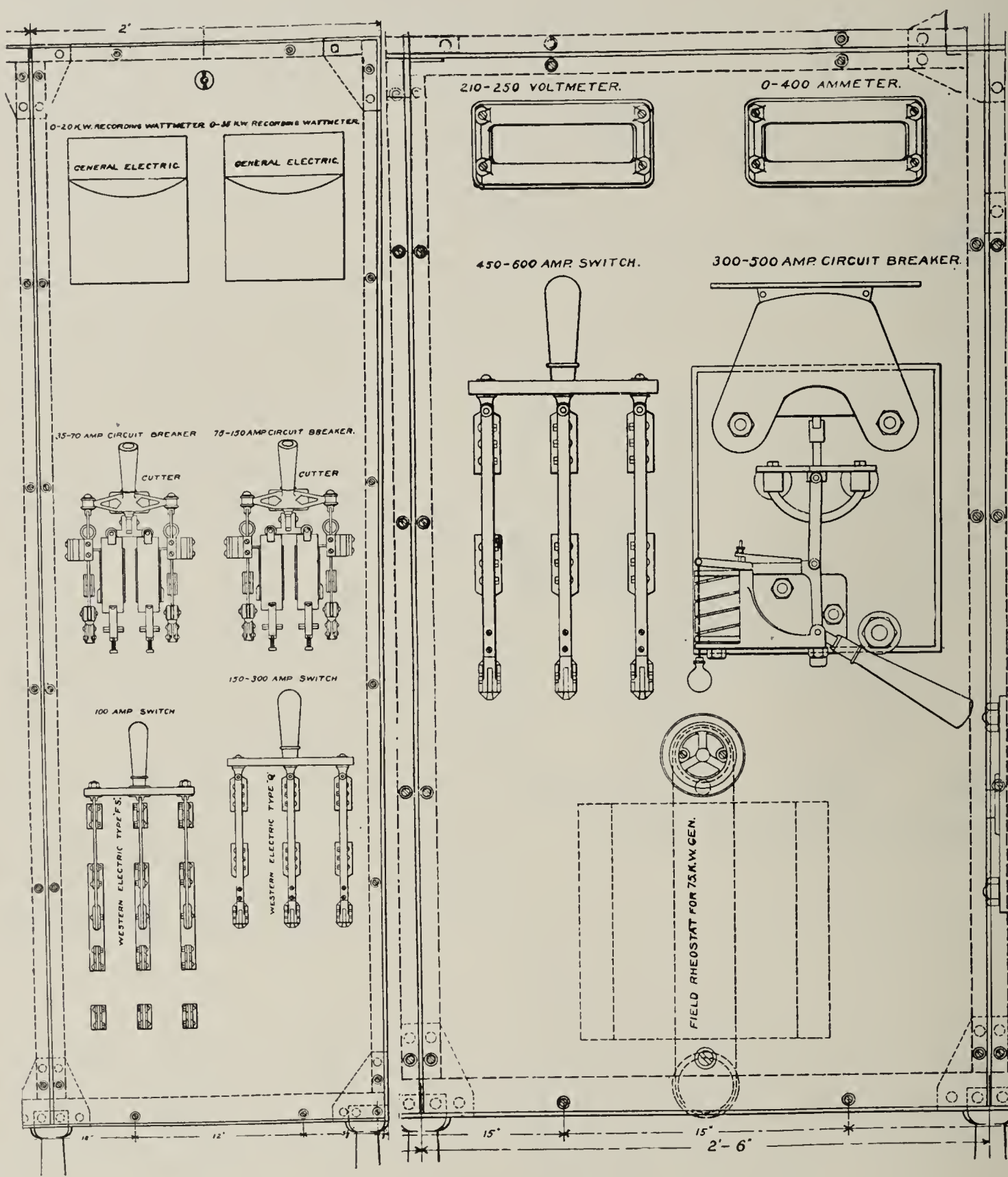


FIG. 5.

FIG. 3.— DYNAMO PANEL.

initial expense, greater complexity and augmented cost of maintenance far outweighs any such saving, particularly when live steam must be added to the exhaust to supply the heating system. The same reasons apply to the use of a condenser. During the portion of the year when steam is not needed for heating the building, a condenser, provided cheap water is plenty, may be advantageously operated, but during the heating season it is more advantageous to exhaust directly into the heating mains and to omit entirely the use of a condenser. Under no circumstances apply a condenser where city water is to be used for the purpose, for the price charged for the municipal water supply is very greatly in excess of the saving by the use of a condenser, and even artesian well water is false economy when it has to be pumped more than about two hundred feet.

Generators.—A short time ago it was essential for the designer to draw complete specifications for the generators, and he had to be so much of an electrical engineer as to be able to thoroughly describe all parts of a dynamo, and assure himself that the machine was properly constructed in accordance with his specifications. At present, the half-dozen large dynamo builders in this country have so thoroughly systematized and formulated their apparatus that it is now unnecessary to do more than to decide on the size of the machine, the voltage at which it shall operate, the number of amperes to be delivered with a specified rise in temperature of both armature and field coils, and the method whereby the generator shall be connected to the engine. There is, doubtless, a tendency on the part of generator manufacturers to overrate their machinery, particularly as to the heating limits. It is, therefore, necessary to strictly qualify that neither the armature nor the field coils shall, on continuous running, rise over 80° Fahr. above the temperature of the surrounding room. This limit may seem a low one, but when it is recollected that, in summer, the temperature of engine rooms may occasionally rise above 100° Fahr., it will be seen that this heating limit allows the windings of the generator to rise nearly to the temperature of boiling water, beyond which it is not safe to allow electrical apparatus to go.

To be sure that this specification has been fulfilled it is customary to operate the generators for, say, twenty-four hours continuously on their maximum load, and then to measure the temperature of the windings by determining the increase in the resistance which has occurred between the machine hot and the machine cold, the resistance of the windings having previously been ascertained before the apparatus has been started on its test run. It is also customary to require that the machines shall run sparkless between no load and full load without any change whatsoever in the position of the brushes. Frequently it is also desirable to specify that the field windings shall slightly over-compound the machine sufficiently to make up for a small fall of potential in the building leads, so that under full loads all the lamps may burn fully up to candle-power.

Finally, the most important consideration is the subdivision of the plant into the proper units. It is always essential to provide some reserve machinery, for the very best regulated of human contrivances are sometimes incapacitated. It is always profitable to so arrange the plant that it may during the greater part of the time work at its most economical rating. Experience has shown that, on the whole, four units for the engine and generator plant make the most economical arrangement. These units should be so proportioned that three will be sufficient to carry the maximum load, leaving one constantly in reserve, ready to step in in case of the failure of any of the others. The units should be so proportioned that one unit will be operating at its most economical rating during the period of lightest load, two units should be sufficient for the average load, and three be capable of taking care of the maximum demand. By this means a skilful isolated plant engineer can constantly keep his machinery working at its most economical point.

For the boiler plant it is not so essential to subdivide into as many units. It is, however, advisable to have one boiler constantly in reserve, reserving two boilers for regular service, one of which may be run at average capacity during hours of light and average load, while the second one is put into service during the hours of maximum load.

Switchboard.—The switchboard is the clearing house of the electrical plant. All of the energy generated is delivered

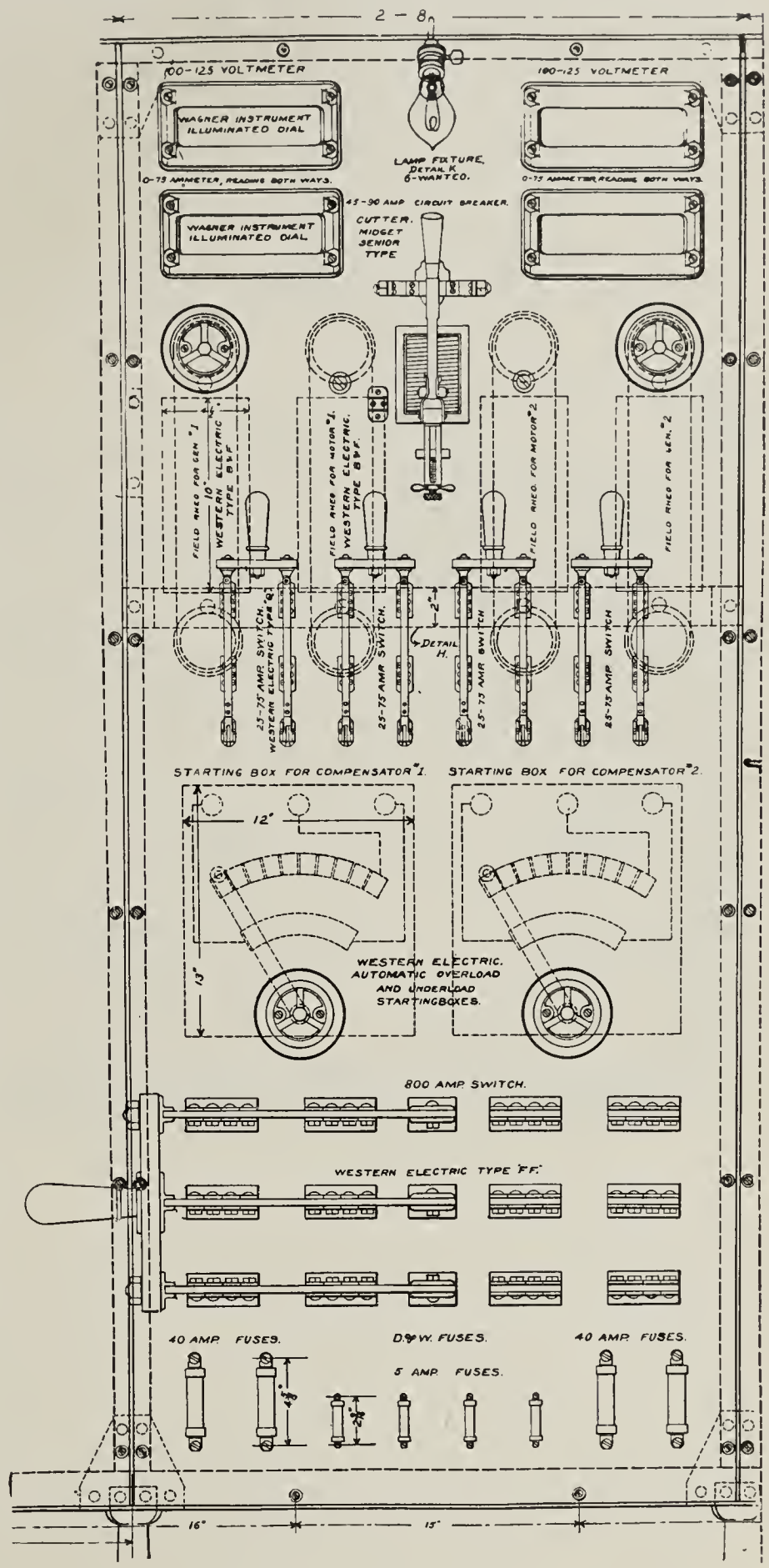


FIG. 7.—COMPENSATOR PANEL.

to the switchboard, and from it is distributed as may be required, and from the readings of its instruments a balance sheet of the performance of the plant may be obtained. The switchboard is also equipped with the indicating mechanism from which the operation of the dynamos is estimated, and furnishes the necessary information to guide the attendant in the manipulation of the machinery. Though the component pieces of apparatus are now well standardized, there is abundant opportunity for the designer to display electrical, mechanical and artistic skill in its arrangement, as probably no two

boards would be built just alike. It is desirable to divide the board into two general parts: First, a series of panels to which the dynamos are directly connected and which carry all of the apparatus for controlling and governing them, for indicating their performance and for providing for their safety; second, a series of panels equipped with the necessary distributing apparatus, whereby the energy delivered by the generators may be guided to the distributing system in any desired manner, the necessary instruments for recording and determining what becomes of the electricity, and such protective devices as may be required to guard the circuits. As each panel is similar to all the others of its kind, a specification and drawing of a typical one of each is all that is essential to the construction of the most elaborate switchboard, for it is simply necessary to multiply the respective panels as many times as there are dynamos or distributing mains.

In general the board consists of an appropriate iron frame, built of angles or tees containing a sufficient number of spaces

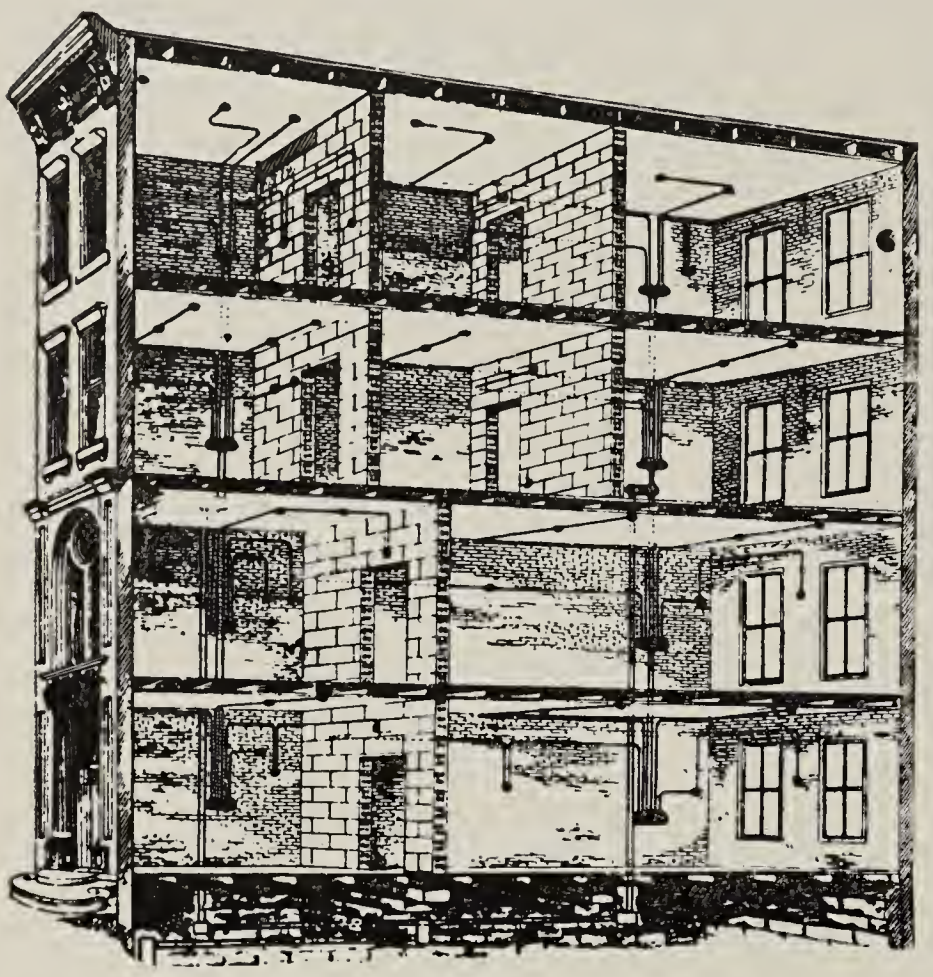


FIG. 8.

to provide room for the requisite panels. These spaces are properly filled with marble or slate, for the designer's choice is limited to these two materials, as nothing else at the present time has been found adequate for the purpose. The generator panel is shown in Fig. 3 and should consist of an appropriate marble slab, upon which is mounted a double pole, single-throw main switch for closing the main circuit from the dynamo. Immediately beyond the main switch should be placed a circuit-breaker, adjusted to the size of the generator. Automatic circuit-breakers are much more desirable in every respect than fuses. They work upon a narrower margin with great accuracy, and may be replaced in case of short circuit much more promptly than it is possible to introduce a fuse. Beyond the circuit-breaker a wattmeter should be placed, to indicate the output of the generator, and in addition the panel should be supplied with a voltmeter and ammeter for giving instantaneous readings. It is almost impossible to obtain a good, permanent switch in which the hinge forms a portion of the circuit; the T. H. wattmeter is probably the best known American instrument for this purpose, while the ammeter and voltmeter should be of the Western or Wagner type. The generator panel should also be equipped with the necessary adjusting rheostat, inserted into the field circuit, whereby the voltage of the machine may be controlled within reasonable limits, and each machine adjusted to run in parallel with the other generators. An equalizing bus bar and switch is also desirable. Fig. 4 contains a diagram of the circuits for this purpose. Beyond the generator panel the machine circuits are extended and secured to the main bus bars which extend along the entire length of the switchboard, receiving the current from all the generators and delivering the same to the various distributing panels.

Each distributing panel (illustrated in Fig. 5, showing a panel with circuits for two floors) should consist of an appropriate switch, one set of points of which is connected to the bus bars, while the other set is attached to one set of distributing mains. Between the switch and the bus bars a wattmeter should be inserted for measuring the amount of electricity to the set of mains in question. An automatic circuit-breaker should also be provided to guard against short circuits. The distributing panel, therefore, is quite a simple piece of apparatus. All parts of the switchboard apparatus should be constructed in the very best possible manner and ample proportions allowed in the connections, switches and wiring, so that there may not be an undesirable fall of potential and loss of energy through the board.

It is customary to specify that, from the dynamo connections to the distributing circuits, there shall not be a drop of more than one-fourth to three-fourths of a volt under full load. The board should be safely and securely mounted, so designed that all instruments may be convenient to the hands of the operator, and set a sufficient distance from any wall or partition so as to give easy access to all parts.

Wiring System. — The reader will probably wonder why no allusion has been made to different systems of wiring. Where an isolated plant is used, this question is of but little importance. A high-tension alternating system would not receive a moment's consideration, and, except in the very largest buildings, the saving in cost of copper by the employment of the well-known three-wire system is so small that it is often outweighed by the increased expense necessitated by more complicated machinery. This is particularly true, since our English cousins have set us the example of the use of 220-volt lamps of low cost and high efficiency. Theoretically, if both sides of a three-wire system be kept in accurate balance, the expense of copper in the conducting system may be reduced to three-eighths of that which it would be were two-wire mains employed. Practically only a half or one-fourth of the copper can usually be saved in building-wiring, and this economy is largely offset by an increase in the cost of installation and more expensive fixtures.

In the case of large buildings, a three-wire system may for its own sake be desirable, and if, as is frequently done, the central station be used as a reserve in case of accident to the isolated plant, a three-wire system must be installed, but then considerable complication is required in the machinery of the isolated plant. All attempts to operate one generator with three brushes have proven failures, so that, if this method of wiring is used, it is essential to make each unit of the generating plant to consist of two dynamos — a most undesirable and expensive complication — or else to use the more modern method involving the introduction of a compensator. This device consists of two small dynamos having their armatures rigidly connected upon the same shaft. The large generators have their brushes attached to the outside mains, while the compensator is so connected between each outside main and the neutral wire that if the system becomes unbalanced on either side the compensator becomes an auxiliary generator and supplies the deficiency upon the side which demands it. The arrangement of main generator and compensator is given in Fig. 6. As the compensators are quite small, usually only one-tenth or one-fourth of the size of the large generators, their installation is relatively inexpensive, but, to avoid an accident, the compensator system must be in duplicate, and proper

panels carrying the switches, starting and regulating rheostats, circuit-breakers, voltmeters and ammeters, must be provided on the switchboard, as shown in Fig. 7.

MAIN CUT-OUT.— If the calculations for economy show that the central station supply is preferable, the high-pressure boilers disappear and are replaced by cheap cylindric heating boilers. The engines, generators and switchboard vanish, while the lighting company extend their mains through the cellar wall and electricity is on tap. Here, however, the designer must provide *a building center;* in other words, a very much simplified switchboard, which usually consists merely of a main switch to provide a means of opening the central station circuit, together with the necessary circuit-breaker or fuses. It is also desirable to install a wattmeter in order to check the total building consumption. Should the central station supply be a high-tension alternating current, a step-down transformer is employed at this point, and the whole apparatus must be set in a fireproof vault outside of the building.

WIRING.— All the work on the building side of either the switchboard or building center is exactly the same, whether an isolated plant or central station supply be employed. For small and medium sized buildings, a set of mains should be extended vertically from cellar to attic as near as practicable in the center of the building, and conducted to the building center or switchboard. At each floor a cut-out box is introduced into the mains, from which the circuits for the individual rooms branch from proper cut-outs and fuses. It is well to provide at this point for the meters, unless it be desirable to install a meter in each room, which is sometimes the case where many small tenants are involved.

For larger buildings it is preferable to extend a set of mains to each floor, as is indicated in a sectional view in Fig. 8, thus rendering the various parts of the building entirely independent of each other, so that a short-circuit at any point only involves the portion of the building in which the trouble is located. Each set of floor mains then should extend to the switchboard or building center, and there be protected by proper fuses and switches. At each floor, also, a proper cut-out box should be installed, from which the circuits to the individual rooms branch in the manner already described.

No method of wiring excepting that of employing interior conduit should be considered, as molding work for first-class buildings belongs to an obsolete electrical past.

The general specifications for conduit work and wiring installation are so completely covered in the National Electric Code that it is superfluous to repeat them here.

Other articles :

Electric Power for Isolated Factories, *Eng. Mag.*, Feb., 1895. The Niagara Falls Plant, *Elec. World*, Feb. 9, 1895. Power Transmission, *Elec. World*, Nov. 10, 1894, *et seq.* Elect. Lighting System, *Elec. Eng.*, April 10, 1895. Electric Wires, *Inland Arch.*, Vol. XIV, p. 72.

MODERN METHODS OF HEATING AND VENTILATING BUILDINGS AS PRACTICED IN THE UNITED STATES.

BY JAMES J. LAWLER.

WHILE there is a possibility in the course of a few years for electricity to take a high place as a medium for the warming and ventilating of buildings in general, it is as yet in its experimental stages, as well as being entirely too costly for general use from a commercial point of view, and will, therefore, receive no further consideration in this article.

There are, practically speaking, but two general mediums for the warming and ventilating of any class of building through which great perfection can be attained from any point of view, and these are steam and hot water. In the utilization of steam as a heating medium, there are many methods employed in construction of the heating plants, and this is due to both circumstances and conditions. We have, therefore, systems which are specially adapted to certain classes of buildings, and which possess great advantages for such special work.

There being no universal standard method of construction for the various classes of buildings, each heating engineer or architect, as a rule, arranges the heating plants to his own notion, and the result is that hardly two heating plants, even in the same class of building, can be found constructed in the same manner, and this proves that there is still a large amount of experimenting constantly going on in the steam-heating field.

STEAM BOILERS AND THEIR CONSTRUCTION FOR HEATING PLANTS.

In constructing a boiler for a steam-heating plant, there are two specially important points to be taken into consideration, the first being that of safety, and the second important point is economy in the consumption of fuel. In making such selection the general method employed in the plant to be installed will have much to do with this decision, but the pressure of steam to be carried on the boiler should have the most weight in deciding on the type of boiler to be used.

If the boiler is to be used solely for the purpose of warming the building on what is known as the low-pressure gravity-return system, which means that five pounds pressure of steam per square inch will be the limit carried, almost any type of boiler may be used with safety, provided that such boiler is equipped with a reliable safety valve of proper size. This low pressure of steam will not answer for power purposes, and, therefore, such systems are limited in their utility, because there are so many buildings that require steam from the boiler for power purposes, as well as for the heating of the buildings.

There are two general types of steam boilers used for steam-heating plants and power combined; one is the ordinary horizontal tubular style, and the other is the water-tube or pipe system of boiler construction, and there is a great difference between these two types of boiler from the standpoint of safety against explosions, in favor of the latter. To explain the reason why the ordinary shell boiler is more dangerous under high pressure of steam than that of the water-tube type,

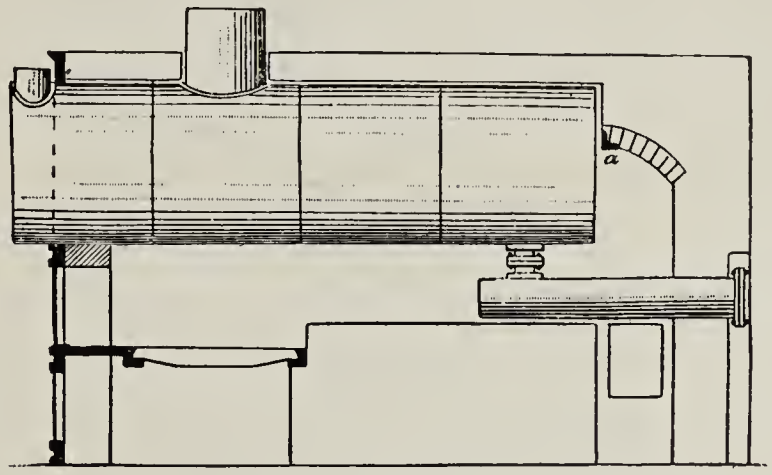


FIG. 1.— THE FIRE-TUBE TYPE OF BOILER.

we make use of the illustrations, Fig. 1 and Fig. 2. In the horizontal tubular boiler, a single shell holds all the water and steam, as shown in Fig. 1, and through which the fire tubes pass, and in order to secure large fire surface, the shell or body of boiler must necessarily be large, and this means a greater quantity of water to be carried in the boiler. One of the reasons why the increased diameter of a shell or tubular boiler decreases its resisting power against internal pressures is because the thickness of the metal is not as a rule increased in proportion.

The illustration, Fig. 2, will answer to show the general construction of the water-tube or sectional-tube boiler, which consists principally of pipe from two to three inches in diameter, and usually placed in an inclined position, as shown in illustration. To increase the capacity of the water-tube boiler, it will be simply necessary to add additional sections of tubes having the same diameter; hence this in no way weakens the boiler;

AT COLUMBIA COLLEGE.
McKim, Mead & White, Architects.

AT UNIVERSITY OF PENN.
Cope & Stewardson, Frank Miles Day & Brother, Wilson Eyre, Associate Architects.

AT CHICAGO UNIVERSITY.
Henry Ives Cobb, Architect.

AT YALE COLLEGE.
Charles C. Haight, Architect.

A GROUP OF NOTEWORTHY EDUCATIONAL BUILDINGS.

neither does it add as great an increase of water for the additional surface as that which would be necessary in the shell type of boiler. It will, therefore, be seen that the water-tube boiler will stand the greatest pressure of steam.

When boilers explode it is always due to high pressure, and that which is the cause of the greatest damage on such occasions is the water contained in the boiler at such times. If we consider for a moment the space occupied in the boiler by the steam, and that which is taken up by the water, and at the same time remember the specific heat of both, we will clearly understand why the water can be the cause of the greatest destruction in the case of an explosion. Water in a steam boiler under steam pressure carries the same temperature as that of the steam, and boilers used for high-speed engines which operate electric-light plants as well as to furnish heat for the buildings, carry from 80 to 110 pounds pressure of steam

FIG. 2.—WATER-TUBE TYPE OF BOILER.

per square inch, and this means that the water in such boilers will have a temperature of from 323 to 344 degrees, and its expanding force will be 1,600 times greater than that of the steam when liberated from the boiler, as would take place in the event of an explosion.

Experience has taught us that the many mysterious boiler explosions can be traced to a want of sufficient strength to withstand the pressure. This lack of strength may be inherent in the original construction of the boiler, but is most frequently the effect of the weakening of the iron by strains due to unequal expansion caused by unequal heating of different portions of the boiler; or it may be due to corrosion from long use. If steam boilers are properly proportioned and constructed, they will, when new, be safe against considerably more pressure than the safety valve is set to; and the hydrostatic test, properly applied, may discover faults in material, or the weakening effects of corrosion; but against the danger resulting from unequal expansion, ordinary boilers such as the horizontal type have no protection. In getting up steam many boilers will be very hot in some parts, while other parts will be cold, and under these conditions enormous strains must occur in some parts of the boiler, which parts are thereby weakened, and these strains being frequently repeated, will eventually so far destroy the strength of the line or point of greatest strain that rupture must result. Generally the rupture is small and gradual, but sometimes large and productive of disastrous explosions. Want of local circulation of water in boilers is a frequent prolific cause of unequal expansion.

Another source of great danger in the shell type of boiler is low water, and constant vigilance is required to keep the water at a proper height. In many boilers the fall of only a few inches in the water line will cause the crown sheet or some other portion to be exposed to the direct action of the fire, whence it becomes quickly overheated and weakened to such an extent that an explosion is likely to occur. Another frequent cause of unequal expansions and also of weakening by burning and blistering the iron is the presence of deposit or scale on the heating surface. This is liable to occur in any boiler, but in very many there is no adequate provision for removing it when formed, and this is particularly the case with tubular and "locomotive" boilers.

HOW TO PROVIDE AGAINST EXPLOSIONS.

Very much thought and experiment have been expended on this problem, but though many forms of boilers have been produced, which have attained practical safety from explosion, yet in many of them there have been ignored certain elements necessary at the same time to make them valuable as generators of steam for practical work. Hence the very name of safety boiler has become to some persons evidence of undesirability. But safety is not incompatible with other essentials of a perfect steam generator, and may be secured without detracting from any other feature.

The first element of safety is ample strength. And this can be best attained in connection with heating surface by small diameters of parts, and it will therefore be seen that where high pressure of steam is to be generated, the sectional water-tube boiler of proper construction stands in the front rank from the point of safety against explosions.

A SPECIAL ADVANTAGE IN THE SECTIONAL BOILER

lies in the fact that it can be placed in any building without having to provide special openings in walls, which are necessary in most buildings to admit the shell or horizontal tubular type of boiler.

HOT-WATER GENERATORS FOR HEATING PLANTS AND DOMESTIC WATER SUPPLY.

As the general practice of hot-water heating in this country is that of the open-tank or low-pressure system, which will have simply a hydrostatic pressure due to its water's highest level, and which is open to the atmosphere, and on this account can not carry a temperature higher than the boiling point — 212° — there need be little fear from explosions even though any type of boiler or heater is used. Yet experience has taught us that special requirements are necessary in the construction of these boilers for this special purpose in order to obtain the best results, and we therefore find a wide difference in the efficiency of hot-water generators from every point of view.

Cast iron is used in the construction of hot-water heaters at the present time to a much greater extent than any other material, and while cast iron will have sufficient strength to resist the necessary pressure when constructed on good principles, as well as possessing a quality which better resists the corrosive action of hot water than wrought iron, there are other reasons for the more general use of cast iron for such purposes. While there is to be found in this country a large number of thoroughly experienced and reliable manufacturers of cast-iron heaters whose advice and goods can be relied upon, there is also to be found a much larger number of individuals who are flooding the market with things called boilers that are mere snares and deceptions without any qualification in their favor except price, and this is placed on the basis of scrap iron. It is therefore not to be wondered at when we find great differences in estimates submitted for the installation of steam and hot-water heating plants.

DIRECT RADIATORS FOR STEAM AND HOT-WATER HEATING PLANTS.

As a matter of fact, there is nothing connected with the heating of buildings in which greater improvements have been made during the last few years than in the efficiency and design of direct radiators. It is but a very short time since we had to be contented with ungainly heaps of cast iron, or what was still more of an eyesore — pipe coils, scattered throughout the

house, which would remind one more of a factory or a machine shop than anything else. But these clumsy devices of former years have been superseded by radiators, whose gracefulness of outline, delicacy of design, and artistic beauty are in harmony with the requirements of modern architecture.

To such perfection have they brought the direct-steam and hot-water radiation that any style of architecture can be matched in the most elaborately finished rooms of any class of home or building by glancing through the showrooms of up-to-date radiator houses.

Not only can we find handsome and satisfactory designs, but more convenient shapes and sizes to meet practically any situation without departing from the heating efficiency of the same.

SPEAKING OF DIRECT RADIATORS,

when we are making a selection of such parts of the heating plant of our modern home, there are two very important points which we should carefully consider. One is the efficiency of the radiators for properly warming the space intended to be warmed by such, and the other is the finish and style of the radiator.

It must be remembered that radiators are specially designed for locations of plain finish, and where finish or style is not necessary, and there are also specially designed radiators for the parlor, so that it is a simple matter of making the proper selection to get what we want in this line.

A few years ago the writer was invited to submit a proposition to warm a building with steam, and, after looking the place over, asked what style of radiator was wanted (which meant direct or indirect radiation); the owner of the building, not understanding the question, replied, "It is not style we want, but heat." These kind of people, too, have gone, and the heating engineer of today must give both style and heat.

PRACTICALLY NO WASTE WITH THE BEST HEATING METHODS.

As late as a quarter of a century ago there was very little knowledge of or attention given to the important subject of heating and ventilating of buildings. But today it is recognized as one of the most highly scientific and important professions, and while there are many things yet to be discovered regarding this important problem, with the improvements already accomplished as used in the most modern heating plants, there will be little more to be desired.

The main object sought for by the heating engineer is to have a pure atmosphere at a healthy and agreeable temperature at all times in the various apartments of the building to be warmed; and to accomplish this it will be an utter impossibility without the use of some reliable system of AUTOMATIC REGULATION.

Another special object desired, not only by the heating engineer, but by those who must pay for the necessary fuel, is the economy in the consumption of fuel, and, to accomplish this, there is nothing known better than a proper system of automatic regulation, as well as the proper insulation of all steam and hot-water pipes, and heat channels located in places not intended to receive heat from such sources. It is astonishing the amount of fuel that is wasted in large steam or hot-water heating plants where no system of automatic regulation or insulation of the pipes is found. There is no better investment from buildings, where steam and hot water is to be carried any great distance, from a money point of view, than that which can be saved by the proper installation of such pipes with good, nonconducting coverings, not to speak of the protection which such insulation gives to the woodwork and other important structural materials.

It must be remembered that in steam and hot-water heating plants there is an enormous amount of heat lost in transit to and from the points of delivery, and in large plants this often amounts to many horse-power which must be provided for in the capacity of boilers for such heating plants, providing the pipes are not to be covered, and eighty-five per cent of this loss can be saved by using a good quality of NONCONDUCTING COVERING on all pipes not intended as heating surface; and it will also be seen that where pipes are to be covered there will be a large saving in the first cost of boilers, which will often equal the cost of the pipe covering for such heating plant.

AUTOMATIC HEAT REGULATORS, TEMPERATURE CONTROLLERS, AND FEED-WATER HEATERS.

For the more economic utilization of steam or fuel, the three special systems or appliances mentioned above take most important parts. I have stated in another part of this article that one of the best investments from a money point of view in connection with any heating plant is a good system of automatic regulation, and there can be no question about such a system being a most important feature from a hygienic point of view.

There are so many conditions to contend with in the warming and ventilating of buildings, that to secure anything like a uniform temperature of apartments to be warmed without some system of automatic regulation is utterly impossible. Where temperatures are not controlled by special mechanical means there will surely be a loss of heat, and this means waste of fuel.

The stationary steam engine would be an unsatisfactory as well as a wasteful piece of mechanism without its governor to control the supply of steam according to the load to be carried, and this is just what a heating plant is without a good system of automatic heat regulation. The conditions with which we must contend in endeavoring to properly warm a building are constantly changing, and this is one of the reasons why it is impossible to secure either the desired quantity or quality of heat for any given time by human attention.

TEMPERATURE CONTROLLERS.

In large apartment houses, as well as in hotels and other institutions where large quantities of hot water are necessary for culinary and bath purposes, steam is found to be the most simple means of warming such water, and it is also the most economical in consumption of fuel, as exhaust steam from engines is utilized for this purpose as well as live steam. But such hot-water heating systems should in all cases be equipped with thermostatic temperature controllers, which can be set to carry the water at the desired temperature for purposes mentioned above, no matter what the pressure of steam supply may be, so that in this case the temperature controller would not only cause the water to be delivered at the desired temperature, but would protect the apparatus against heavy strains due to unnecessarily high temperatures, and prevent any waste of steam.

Another source of revenue in connection with steam-power plants, which is now universally used in best constructions, is the

FEED-WATER HEATER.

There is no better coal or fuel saving device, where steam is used for power purposes, than the feed-water heater; for the reason that while exhaust steam from engines may be utilized for the warming of buildings in cold weather, it will not be necessary for such purposes in summer, but the feed-water heater can utilize the exhaust steam to advantage in summer as well as in winter. To show in a brief way the great economy in a good construction of feed-water heater, we will consider what is accomplished by such a device. As already stated, water in steam boilers under pressure of steam has the same temperature as the steam therein, so that it is necessary to raise the temperature of all water which enters the boiler to that of the steam carried, and, as also stated, high-speed engines are usually run with a steam pressure of 80 to 100 pounds per square inch, which is equal to 324° Fahr. Exhaust steam in passing from the engine to the feed-water heater will usually be found to have a pressure of about three pounds per square inch; this pressure of exhaust steam also means a temperature

of about 221° Fahr., which is transmitted to the feed-water before entering the boiler. It will therefore be seen that there will be but 103 degrees to be added to the temperature of this heated water after entering the boiler to generate steam at 80 pounds pressure per square inch, and allowing that the cold water before entering the feed-water heater had a temperature of 35° Fahr., there will be found to the credit of the feed-water heater 186 degrees of heat out of the required 324 degrees, or nearly two-thirds saving in the total consumption of fuel.

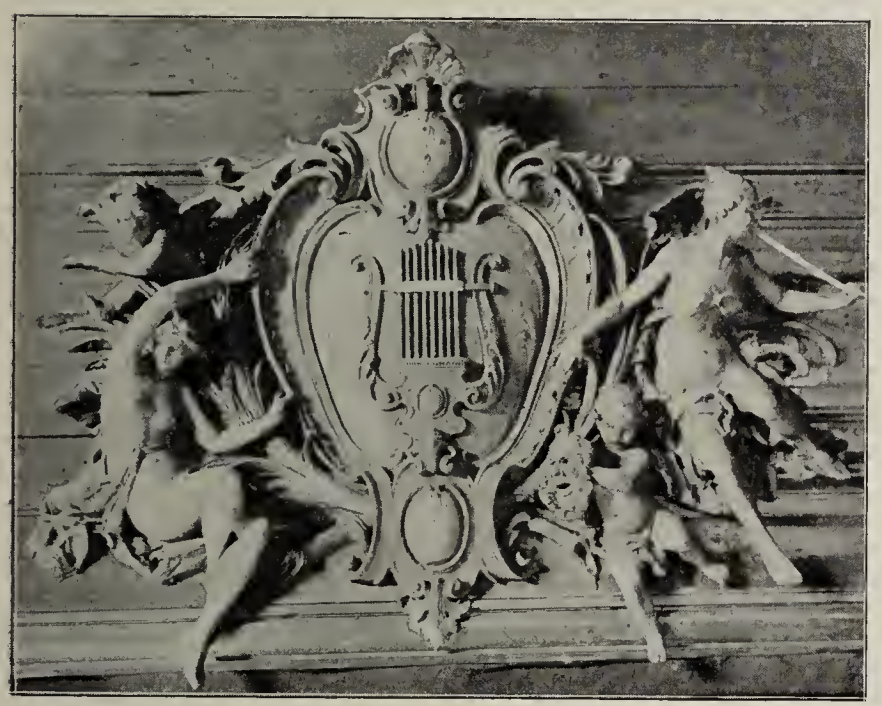
For further investigation, see

Feed-Water Heaters, *St. Ry. Jour.*, April, 1895. Heating a Hotel by Steam, *Eng. Rec.*, Dec. 2, 1893. In a Hospital, *Eng. Rec.*, April 28, 1894. School Building, *Eng. Rec.*, May 12, 1894. Heating Plant Tested, *Eng. Rec.*, June 28, 1894. Proportioning of Ducts, *Eng. Rec.*, Feb. 16, 1895. Comparison of Hot Water and Steam Systems in Municipal Buildings, *Jour. Assn. Eng. Socs.*, 1895, Vol. XV, No. 4. In Tall Buildings, *Eng. Mag.*, Vol. IX, No. 3. The Blower System, *Tech. Quart.*, July, 1893. In Pub. Bldgs., *Inland Arch.*, Vol. VII, p. 26; Vol. VIII, p. 60. H. and V., by Willett, *Inland Arch.*, Vol. XXI, pp. 35, 47, 60, 73. Mechanical, *Inland Arch.*, Vol. XXIII, p. 50; Vol. XXIV, pp. 2, 13, 23, 43, 54.

ARCHITECTURAL SCULPTURE.

BY MAX MAUCH, SCULPTOR.

ARCHITECTURAL sculpture was one of the first efforts in the direction of art. The aim from the beginning has been to bestow upon a building charm and variety by means of harmonious lines and forms. This art is also applied



THEATER DECORATION.
Beil & Mauch, Sculptors.

to explain the purpose of a building or to hide a defect in the construction. For the architect this art is of the same value as style is for the author; that is the means to connect gracefully one idea with the other, hence the use of the word "style" in architecture. Therefore, in earlier times, where specialists in this branch were not known, the architect was his own sculptor; later on he associated with a sculptor to carry out the architectural and plastic forms in such a way that one necessitated the other. The technical progress of our present day, by means of which it is possible to complete buildings in one-tenth of the time required formerly, interrupted to some extent this harmonious collaboration. In the last hundred years architectural sculpture has been lowered to an applied decoration which could be left out without injuring the general appearance of a building. Only the latest productions in architecture promise a regeneration of the art in architectural sculpture.

The different branches of this art are divided, according to the various building material used, into stone-carving, terra-cotta modeling, bronze and iron casts, wood-carving, stucco and ornamental plastering, etc. Until a short time ago it was understood that an ornamental sculptor was apt to work in all these materials. Lately, specialists of these different branches have developed, not to the advantage of architecture, and it is to be hoped that this mistake will soon be corrected by the higher aims of an advanced architecture. The most prominent

STUDY BY HENRY LINDER, SCULPTOR.

architects of this country have actually fostered this view by employing sculptors for all the models required for one building, contrary to the custom of allowing the manufacturers to employ their own modelers. In doing so they greatly improved the architectural sculpture.

Referring to the different classes of buildings where architectural sculpture is employed, we may first mention government and public buildings. Although neither time nor money is spared in the construction of capitols, courthouses and post-office buildings, and a great display of sculpture is shown in the same, nothing notable, but rather inartistic and clumsy

DESIGN FOR SUN-DIAL.
Henry Bacon, Architect. A. A. Weinman, Sculptor.

execution, is characteristic of this class of work. The cause of this seems to lie more in the insufficient regulations than in the lack of ability of the sculptors employed. For instance, the buildings for educational purposes have proved to be very fertile ground for art, especially libraries and universities; among them the libraries of Washington and Boston, the Columbia College in New York and the University of San Francisco show what our sculptors are able to do if they are allowed to execute the products of their fancies in pure material.

Referring to our office and business buildings, the requirements of our democratic time are in many ways against the employment of sculpture work to any extent, as their main care is to provide space and light. Therefore only flat ornamentations are employed for their decoration. The decoration required in churches now is insignificant as compared with that of former centuries, when hundreds of artists were chiefly employed in such work.

The idea of building a homestead for centuries has vanished in this era of railroads. The owner is aware of the fact that he may be compelled some day to sell his house on short notice; he therefore prefers to satisfy his artistic desires by means of movable pieces of art in preference to adornments connected with the building itself, as those embellishments prove in many cases to be rather a disadvantage in securing a purchaser.

In reference to interior decoration, the architectural sculptor is limited to theaters, halls, clubhouses, restaurants and saloons, which latter, in the public opinion, are not to his advantage. In contrast to this, one of the most attractive grounds for the sculptor are the exhibition buildings, which during the last thirty years have given to them the best opportunity to show their power, although very rarely in any other material than staff. In this field they arepermitted to produce the boldest fancies, modeling enormous groups of human figures; and the greater number of our sculptors of national reputation owe their fame and the admiration of the public to works done in the so-called "White Cities." There is no

doubt that monumental buildings and exposition buildings will in the future represent the only opportunity for the sculptors to make themselves acquainted with the desires of the people. In this work they will find a compensation for what they have lost in the building of churches and castles of former days. The number of those employed in this art in this country is yet very limited, and restricted to a few of the large cities only. This small number is still complaining of insufficient occupation. Not appreciating the value of artistic work, owners and architects often make the mistake of letting this work to a general contractor, the stone-carving to the stonecutter, wood-carving to the carpenter or cabinetworker, and the ornamental stucco to the plain plasterer. It is evident that the contractor will be mostly interested in his own work, and will try to place the art work with the lowest bidder. The artist as a subcontractor will always offer a pitiful feature, working without zeal and self-consideration.

QUADRIGA OF VICTORY, BY J. Q. A. WARD.
Surmounting the Dewey Arch, New York.

It would be desirable that the architects should pay more attention to the architectural sculptor's work, calling repeatedly at their studios, criticising their work and encouraging the artists and their assistants by praises or censuring. There is also such an amount of technical knowledge required, which can only be secured by viewing the work in progress, and without which knowledge no architect will be able to do himself credit in making designs and details. The sculptors know by experience that they never will be able to explain the particulars of their business in words, and there are no technical books which would fully explain, as their work can only be understood by carefully watching its progress. I therefore will not attempt to enter this field.

FINE INTERIOR WOODWORK.

BY F. E. KIDDER, C. E., ARCHITECT.

NEVER in the history of this country has such fine work been done in woods, at least for house finishing, as is being done today. It is true that some very good work was done in the Colonial period, especially in stair and mantel work, but most of the work was painted, and the members were not as fine as at the present day. It is, in fact, difficult to find a piece of Colonial work that would be considered first-class in execution by the architects of today. True, the Colonial work, being entirely done by hand, possessed an individuality that is lacking in machine work, but in the best modern work the individuality is obtained by special designs, inlaying and carving.

Even at the present time, however, a great deal of woodwork is decidedly inferior to the average of that done one hundred and fifty years ago, because of the rush with which everything is now done, and the low prices at which much work is taken. Then, again, house carpenters do not as a rule learn their trade as thoroughly now as in the olden times. Indeed, the modern house carpenter is employed mostly on rough work, and the only fine work he has to do is in putting up the finish, which has been worked, smoothed, sandpapered and largely put together at the mill. The trade of the joiner has merged into that of the cabinetmaker, and is followed only by those men who work in a mill or factory.

To obtain a strictly first-class job of fine interior finish, outside of a few of the larger cities, is a difficult undertaking,

and one that requires a great amount of watchfulness as well as technical knowledge on the part of the architect, great care in preparing the walls and rough work to receive the finish, good mill facilities, with ample floor space and skilful men to do the work and time to get it out, and much money to pay for it. As with nearly everything else, a beautiful room depends

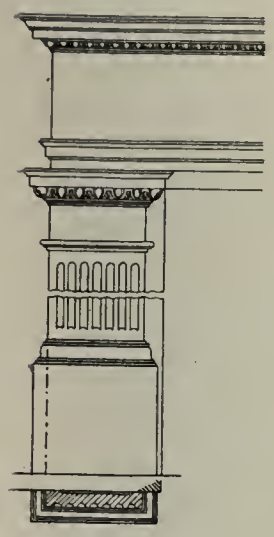


FIG. 1.

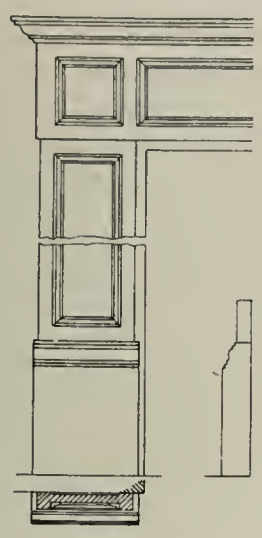


FIG. 2.

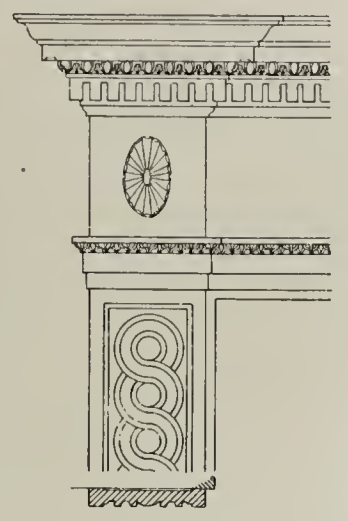


FIG. 3.

very largely upon the work and artistic thought put into it, and without these the work can not be a success, no matter how rich the materials employed. For the best work, however, of course only fine materials should be employed.

The defects in interior woodwork are due to many causes, the chief of which, perhaps, is that not enough money is paid and time allowed for the work. Even when these causes are eliminated, however, the finish may be only second or third class, because the walls were not dry, the grounds were not properly put on, the plaster was not true to the grounds, the

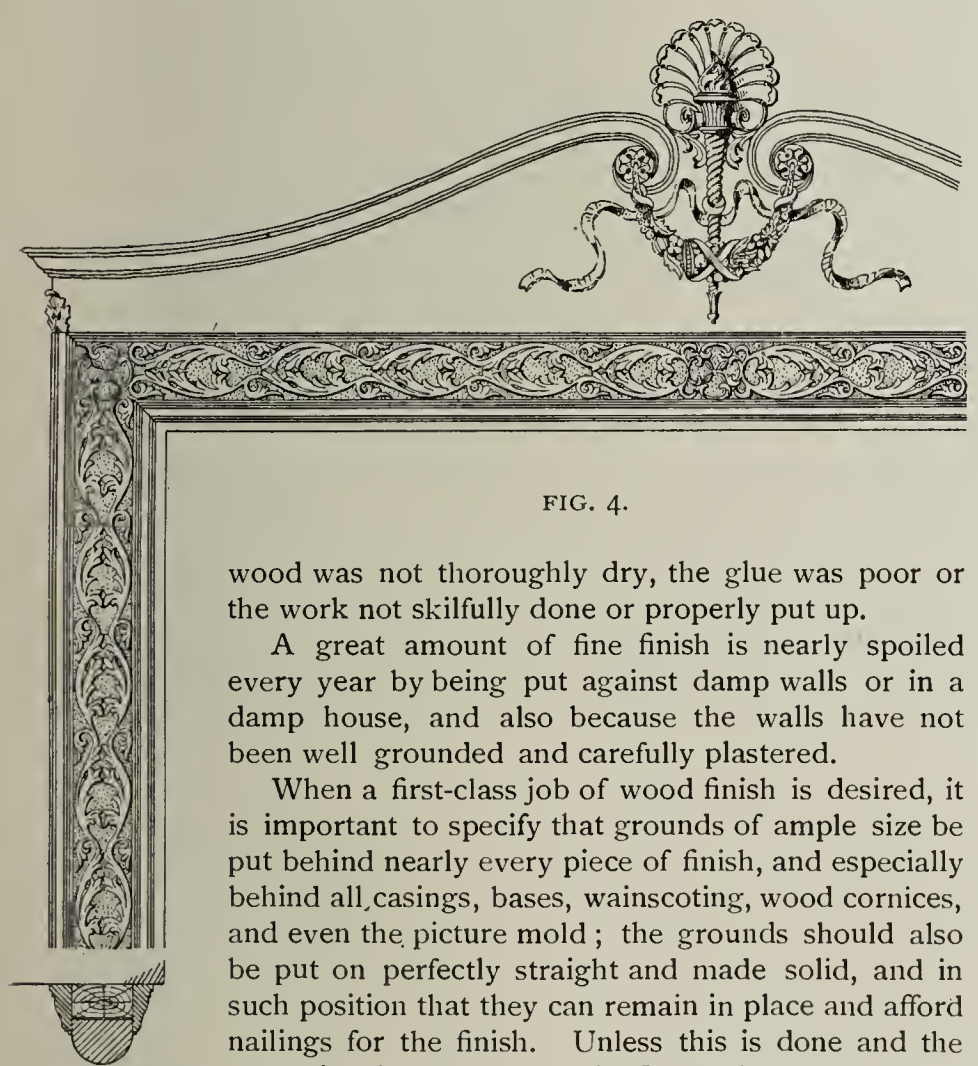


FIG. 4.

wood was not thoroughly dry, the glue was poor or the work not skilfully done or properly put up.

A great amount of fine finish is nearly spoiled every year by being put against damp walls or in a damp house, and also because the walls have not been well grounded and carefully plastered.

When a first-class job of wood finish is desired, it is important to specify that grounds of ample size be put behind nearly every piece of finish, and especially behind all casings, bases, wainscoting, wood cornices, and even the picture mold; the grounds should also be put on perfectly straight and made solid, and in such position that they can remain in place and afford nailings for the finish. Unless this is done and the plastering brought perfectly flush with the grounds, it will be found that the plastering is wavy, perhaps out of plumb; and altogether in such shape that it is impossible to bring the finish to the plaster without twisting or springing it, and often it can not be brought against the plaster except in a few places. It has been the writer's experience that it is more difficult to get the walls properly prepared for the finish than to get good finish. The condition of the building when the finish is brought to it is also a very important factor. The plastering should be thoroughly dry, and the rooms as free from moisture as it is possible to have them.

The best time of year in which to finish a building is in the winter months, as the heating apparatus can then be kept in operation and the air kept dry. In the summer months the workmen can not endure artificial heat, and the air in the rooms is consequently of about the same humidity as that outside. Even on the hottest summer day the air is not nearly as dry as in a furnace or steam heated house in winter, and in some localities dry air in summer is quite uncommon. The main point to be considered and attained as closely as possible is to have the wood dried in a kiln or "hot box" to such a point that the artificial heat in winter will not affect it, and to get it from the mill to the house and in place and varnished or painted without its absorbing moisture. This is something quite hard to do, but it can be done.

The designing of the finish, i. e., in regard to the way the pieces of wood shall go together or be built up, also has a great deal to do with the final appearance of the work. That the finish shall be worth the labor and thought expended on it, it should obviously be of an artistic and appropriate design, but this can usually be attained in several ways, and it is better to use a comparatively plain finish that will stay in place and not show open joints than to use a more elaborate finish that will open at nearly every joint. In designing standing finish, therefore, the architect should first consider what the chances are for obtaining the requisite conditions for a first-class job, and if he thinks that it is doubtful about obtaining the necessary degree of dryness, and careful preparation for the work, he will do well to make the finish of such a character that it can be fitted to uneven walls and not be badly affected by shrinkage. It also makes quite a difference whether the work is to be painted or varnished, as in painted work open joints may be filled, but in varnished work any perceptible shrinkage mars the appearance of the work almost beyond repair. The ill effects of shrinkage may be largely overcome by avoiding miter joints and either using corner blocks or treating the casings as pilasters, with caps or corners made of a separate and slightly thicker piece. Pilaster casings with corner blocks, which may be carved if desired, is the simplest finish for avoiding the effect of shrinkage, and when something better is desired a finish like that shown in Figs. 1, 2 or 3 may be used. Neither of these designs will suffer much from shrinkage. For very fine finish, where all the conditions are favorable, the work should either be built up with several narrow members or the broad surfaces veneered on a pine back. The work should also be put together at the mill as far as possible, and painted on the back and filled and shellacked on the surface before it leaves the mill. In the best work the head and side casings are joined together at the mill, so that no joints have to be made at the building, and if the wall is perfectly true but very few nails will be required to hold the work.

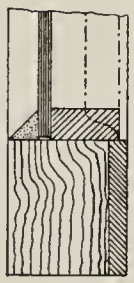


FIG. 5.

When the casings are quite thin, however, unless the walls and grounds are perfectly straight and in line with the edges of the frame or jamb linings, it is better to put up the finish piece by piece, as if put together at the mill the joints are liable to open in fitting the finish to the wall.

A better job of work can usually be obtained by using comparatively thick finish rather than thin. Fig. 4 shows a section of door finish recently used by the writer, which was all put together (except the head ornament) at the mill, and was very easily secured in place. Finish like that shown in Fig. 2 can be framed together with mortise and tenon, and make a very strong joint. In the finish shown in Fig. 1 the pilasters should be got out complete at the mill, with all moldings glued on and the head casing made complete, but each should be put up separately. If there is any chance for shrinkage, however, then the

cap should be a separate piece and the moldings nailed on instead of gluing. For a first-class job the finish shown in Fig. 3 should be all put together at the mill, with the side casings extended to top and the head casing framed into it. With finish such as is shown in Figs. 2, 3 and 4 it is possible to glue the finish to the edge of the door frames, holding it in place till the glue has set. The writer is informed that in Scotland nearly as much glue is used at the building as at the shop, and that everything is glued wherever possible. The best work in this country is largely put together with glue and perhaps a few screws. Such work, of course, must be very carefully done and requires a good deal of time and ample room in the shop. It is doing no injustice to say that not every mill is equipped for getting out first-class wood finish.

There are a few details of finish that may be briefly touched on as being important in first-class work.

Veneering.—Veneered work is undoubtedly superior to solid work, if the veneering is properly done, and certain kinds of hardwood finish, such as doors, wide panels or friezes, must be veneered to give any sort of a job. Even a first-class pine door should be veneered. The advantages of veneering are that the wood, being very thin, is thoroughly dried, and when applied to a core built up of small, dry pieces of pine, there is no tendency to warp or shrink. Two kinds of veneer are used in housework. The more common kind is about $\frac{3}{16}$ inch thick, and is always sawed. Many of the mills saw it from ⅞-inch boards as needed. The other kind is only about $\frac{1}{20}$ of an inch thick, and some kinds, such as bird's-eye maple and curly birch, are made by cutting off a thin layer around the log. These thin veneers are only made from selected stock, and can be obtained in pieces two or three feet wide, so that a panel three feet wide can be veneered without showing a joint. With the thicker veneers it is necessary to match the pieces, when the work is over 12 or 14 inches wide. Some persons probably have an idea that it is cheaper to use thin veneers than to use solid wood. This is not so except in the case of very rare woods, and where a factory is especially fitted up for that kind of work. The ordinary woodworking establishment finds it cheaper to use mahogany even 1⅛ inch thick than to veneer it, and the very thin veneers are but little used outside of furniture shops and a few mills in Chicago and the Eastern States.

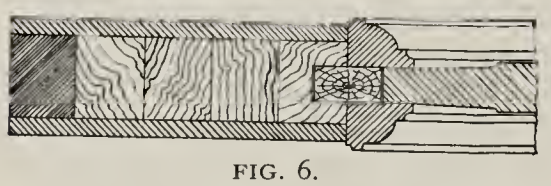


FIG. 6.

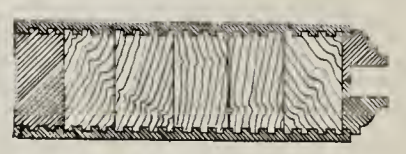


FIG. 7.

Veneered work should always be veneered *both sides* where there is any chance for the work to warp, otherwise it will warp and twist badly. Doors, especially, if veneered on one side, must be veneered on the other, if only with pine. Sash for outside windows, however, may be veneered on one side only, if they are 1¾-inch thick or more. The writer usually has the outside sash for windows showing in rooms finished in hardwood, veneered as in Fig. 5, and has always found them satisfactory.

Panel work should always be put together with loose panels. Doors should be made with a spline to receive the moldings, as shown in Fig. 6, otherwise it is difficult to secure them without gluing or nailing to the panels.

One firm in the country is now making what they call a compound door, the difference from the ordinary veneered door being in the dovetailing of the veneer to the core. (See Fig. 7.)

Hardwood Flooring.—Most of the hardwood flooring now used is manufactured in the lumber regions by concerns that make a specialty of flooring, and is sold to the different lumber dealers throughout the country. Oak and maple are the most satisfactory woods for floors. All of this "stock" flooring is matched, and the best quality is also matched on the ends and bored for the nails. The usual width is 2¼ inches on the face. The stock is supposed to be well air-seasoned and kiln-dried before it is stuck, and considerable pains is generally taken to keep it dry afterward. For a furnace-heated house, however, it should be put in a kiln or hot box for two or three weeks just before being laid. To obtain an absolutely perfect job of flooring the boards should be rejointed by hand as the floor is laid.

Parquetry.—When something handsomer than a plain oak or maple flooring is desired it is best to use *parquetry flooring*. This is now manufactured by several parties in this country, and a very good quality of flooring, in almost any design or any combination of woods, can be obtained. The common thickness is $\frac{5}{16}$-inch, and it is usually made up of slabs 12 or 18 inches wide and 3 or 4 feet long for centers, and 6 to 24 inches wide and 12 feet long for borders.

Thin parquetry should be laid upon a double floor, the upper thickness of which is of kiln-dried clear white pine, furred up if necessary so as to be perfectly level, and smoothed and traversed by hand as if for a finished floor. On top of this pine flooring the parquetry is laid, commencing either with the center or with the border as may seem best, and secured by 1¼-inch wire brads. The brads are driven through from the top and sunk for puttying, from fifteen to twenty brads to the square foot being used where the pattern is in small pieces. Gluing the parquetry to the floor is not recommended.

For further investigation, see:

Timber: Its Properties and Characteristics, Bulletin No. 10, U. S. Department of Agriculture, 1895. Club Furniture, *Inland Arch.*, Vol. XII, pp. 78, 93. Wood Carving, *Inland Arch.*, Vol. XIII, p. 100.

ORNAMENTAL METAL-WORK.

BY W. W. KENT, ARCHITECT.

TO bring beauty out of crudity, form out of mass; to give an expression of life and imagination to materials which await the touch of a creative hand—these are the delightful tasks of the designer.

The fascination of an artist's career lies somewhat in the materials with which he works, that is, in the possibilities which the characteristics of the materials suggest, and he who does not keep within the possibilities of his medium soon reveals qualities of decadence, or, to say the least, of mediocrity. The man who makes in an etching, for instance, an effort to secure qualities which could better be secured by lithography, is working outside the possibilities of his medium. It is, of course, difficult to explain just how far one can successfully go in certain directions with certain materials and processes, but even laymen recognize intuitively when the boundary line of possibility has been passed, and feel an instinctive dislike for the consequent result. It is impossible in brief space to state just what should or should not be attempted in any medium, but there is one fundamental law that designers generally recognize, and in fact one may say that, in such degree as they do recognize it, they may be called artists. That law is that no process should be carried to the point of absolute deception, and no material should be wrought into the semblance of another material, when the resulting shape could better be secured by use of the material of which the characteristics have been imitated. All materials or mediums have peculiar qualities, and he who most keenly appreciates this and knows how to bring them out to advantage is working in the right direction, no matter how far he comes from the ideal. In fact, this gift of appreciation is a distinguishing mark of talent if not of absolute genius.

Let us, for instance, suppose that we wish to make an ornamental panel, and our given or selected medium has as its chief characteristic plasticity. How strained and far from the mark it would be to attempt to carve it, instead of modeling it into the desired form. Again, take a substance which is ductile; would you naturally make its ductility count and come out

strongly in your work, or would you try to mask this valuable quality by making a casting?

These may seem needless questions to ask, but the principle involved is a vital one in all good craftsmanship, if not in all art. On every hand we see in the city streets materials wrongly applied, wrongly wrought. Galvanized iron balances awfully on cornices in forms which it would be unsafe to repeat there in the real article which it falsely represents, and yet galvanized iron has its beautiful uses, properly wrought and placed.

FLORENCE — COVER OF ANDIRON CHEST.
By Michael Angelo. (In the Bargello.)

Of all the current errors of this sort, perhaps the most frequent are those connected with the use of metals, and they are made even in places where we see other work logically and beautifully carried out. We see cast iron masquerading as wrought, in order either to save a few dollars or to show how clever the designer can really be. The story of a famous architect comes to my mind, who found one of his pupils designing with evident labor and pride a queer feature in a house interior in order to escape the results of what the necessities of the case demanded. "That's clever," he said, to the neophyte's joy, and then crushed his budding enthusiasm by adding, "but we never do clever things here."

Now a word for abused cast iron. Why has it been placed so low in the scale of metals which can be used ornamentally? One reason is possibly because it is brittle, another because it is cheap, but the chief reason is probably because its cheapness has led to its substitution for more valuable metals. Can any one say that this cast-iron chest panel by Michael Angelo (now, I think, in the Vatican) is not in a wonderful degree beautiful? If the iron does not lend itself to this design, or rather if the design was not made in keen appreciation of the qualities of the metal, it is impossible to say or guess what could have been the thought which brought design and medium into such perfect harmony. The very incompleteness of certain parts and the bold, but we might say refined, crudity of the figures are delightful. Here, I firmly believe, is one of the great master's most instructive works. Certainly nothing a hundred times grander or richer could tell more of the appreciation which the designer felt for his medium than this. It is sympathetic in the best and strongest sense, and the cast iron has been ennobled by the simple emphasis of its qualities. How would he have done the same thing in bronze? Probably by making a finish where high lights would count with color more than iron would admit of. That is, with possibly more finished and burnished modeling and with greater delicacy of design.

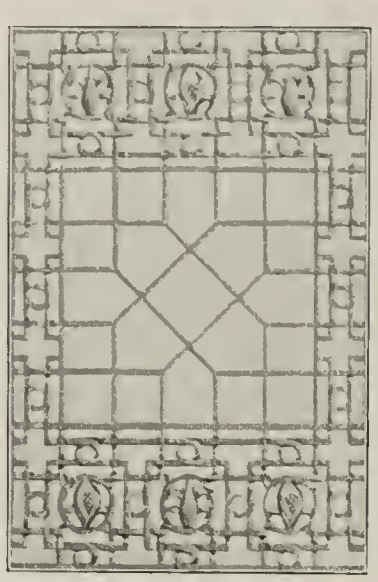
To come down to the Middle Ages, see what the French did with firebacks and andirons in cast iron. You will find excellent examples in the Cluny museum and at South Kensington. Even in England in the eighteenth century firebacks of good design were produced, and preceding this some interesting cast-iron work was made at Lewes, Sussex, the origin of the foundry dating back to the days of Henry II in 1266. A modern bronze casting is represented on page 32 which is purely a design for casting and not for any other method of manufacturing, and is a very interesting and charming design.

The commonest misuse of cast iron is in the imitation of wrought iron or bronze, where cast grilles, hinges, etc., are made to pass as wrought work. As a basis for electroplating and in heavy forms the use of cast iron, although a palpable fraud, is hardly as weak as where the form of a malleable or ductile metal is imitated. An example of a delicate grille made by an American foundry, and of the writer's design, is shown here as an example of the legitimate use of cast iron. The slight roughness of an iron casting is interesting, and by refining or coarsening this, according to the design, considerable life and vigor can be obtained.

In the shaping of wrought iron the commonest fault is not imitation, but a careless use of its malleable and ductile qualities. As a nation we make wrought iron so much more heavy and clumsy than strength and good design demand, that it is in many cases ridiculous if not absolutely offensive. There is of course no hard and fast rule to tie to, but the possibilities of refinement, grace and strength in combination are so well known to an old ironworker that a green hand's efforts at design are quickly detected. Watch the forging of a horse-

shoe by a country blacksmith and you will often see that "the smith, a mighty man is he," for other reasons than that he has strong arms. He feels the ductility of the metal at every blow, and he can often put in a graceful outline with a few strokes.

An interesting experiment was made some years ago at the writer's suggestion to see how good a grille might be made by



CAST GRILLE.

the use of certain stock forms of rosettes made for the trade, when placed on a framework of wrought iron, and the result was interesting if nothing else. The experiment could be carried further, with good chances of securing better results. One danger is avoided in work of this sort, and that is that of representing flower forms in too realistic a way. The stock rosettes have a certain architectural stiffness and dignity which when offset by graceful handwork are exceedingly telling. Realistic roses and other flowers in wrought iron are not apt to be beautiful when entirely freed from conventional handling. In rococo work of the best period we find the safe limit of free treatment reached, and when succeeding artisans passed beyond it the decline was noticeable.

It is in the Orient and among the Latin races that we must look for the best examples of ornamental metalwork in the past. The grilles and gates of the Spanish cathedrals — the braziers, with bronze or brass studs and nails, the wrought-iron bosses on the massive doors of public and private houses, are well known to travelers and students. Mr. Prentice, in his book on the Spanish Renaissance, has given many interesting examples.

Where it is desired to use color on metal, that is, to apply color to it, better results are obtained if paints can be avoided, especially on metal exposed to the elements. Paints fade and run and need frequent renewals. On ironwork the surface may be preserved by the use of several patented processes known to most metal-workers; and when copper, brass and bronze are employed, acid treatments are made especially effective; and by careful experiments I think even better colors might be discovered than we have so far obtained. Just why all modern iron or bronze work should be colored green, irrespective of its place or function, it is hard to say. We see it now on mausoleum doors and café signs, on clubhouse cornices and bank signs, until it seems done to death. There are other acid stains quite as beautiful as Pompeiian green, and while as a scenic effect it may be permissible on the cast-iron railings of the Manhattan Hotel in New York and the roof of the Grand Central station opposite, this is no reason why it should greet us as the correct thing at every turn.

But more beautiful than any superficial coloring are the rich alloys in copper and bronze which the more progressive of hardware concerns have been experimenting with. The chemical laboratory is now an indispensable part of the more modern and extensive metal-working establishments. What glowing richness in the royal red or dragon's-blood copper alloys, every change of any constituent part producing a different tone with all the lavishness of kaleidoscopic or symmetroscopic effects — and, by the way, no designer — whether in glass fabric or metal — should be without the symmetroscope. It has all the advantages of the kaleidoscope and improves upon it immensely. By its use one can photograph the most charming combinations of conventionalized flower and other forms in a constantly changing variety of shapes and colors — of course it not being possible to secure the latter by the camera with any degree of cheapness ; and as yet the pentagon is the basis for all patterns in it as now made, but even with these limitations it is of immense use to all artists.

One other consideration about ornamental metal-work is where properly to use it. Probably few men need to be told of the field there is for it. For both protection and use it may properly be ornamental in character, and the Pompeiians have shown us that even common domestic utensils may be made beautiful, and things for our cooks and maids to admire rather than to smash ; nor do I believe that great expense would follow the good designing of such things, while the effect of beautiful objects on even the dullest mind is, I contend, not only not bad, but positively elevating, in spite of that pessimism which says — and says it often — that all art is degeneration.

Where are the old street signboards of the mediæval craftsmen? Why can we not expect to see a revival of these surpassing all that has gone before? Here was one of the most

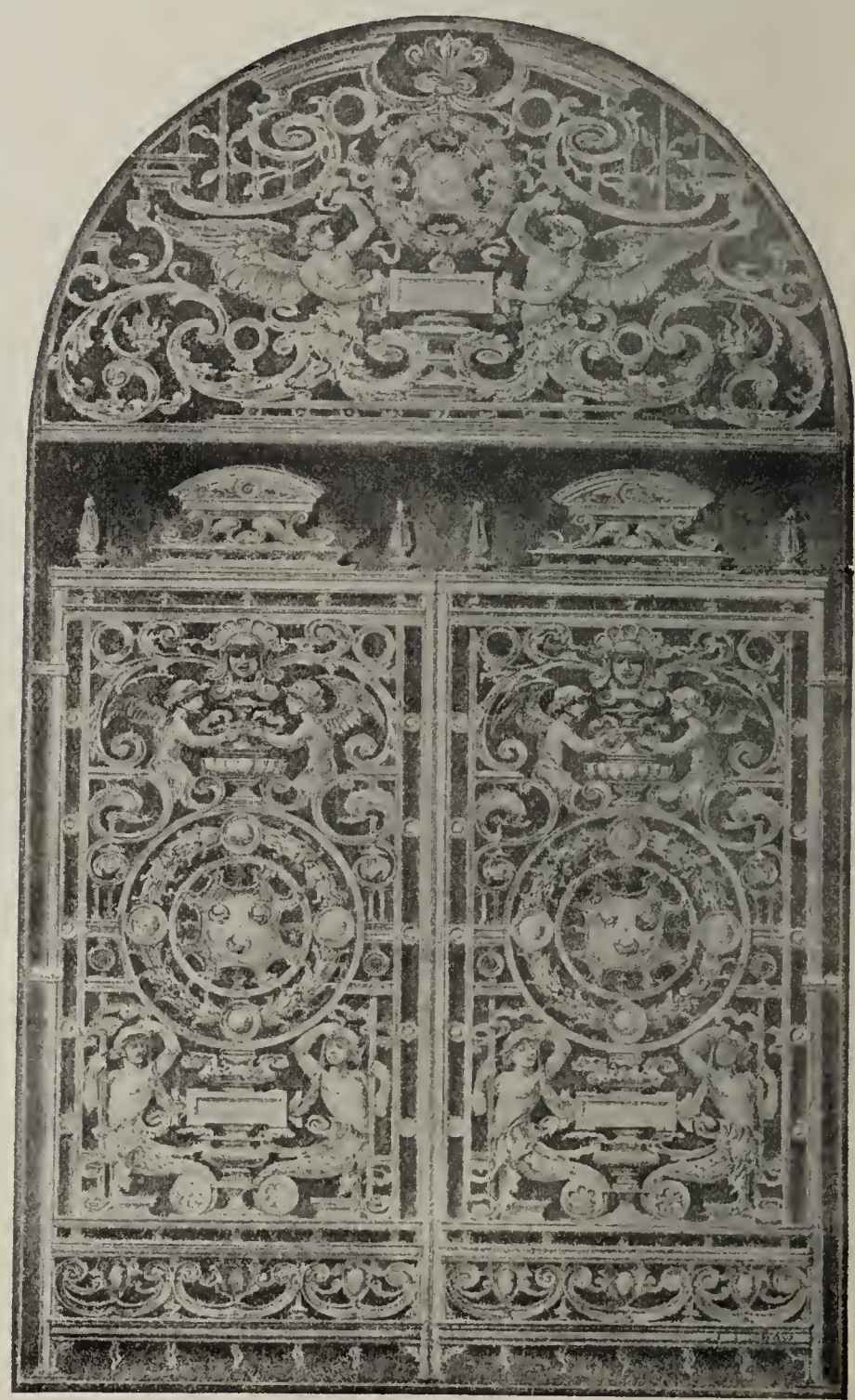


ILLUSTRATION OF CAST BRONZE GATES.

practical applications of metal, the beautiful lines of the supports being a constant reminder to the passer-by that something besides money-getting occasionally occupies the proprietor's mind. We Americans live so much in the business world that it is almost a necessity that we should put into our surroundings at least some few excellent things in design, and I for one must disagree with Ruskin when he says that a chimney is not

GRILLE SHOWING GOOD CONVENTIONAL TREATMENT OF LEAF FORMS.

to be ornamented. Let us make even our factories beautiful and we — well, we may perhaps even do away with the necessity for future Ruskins.

We are, on this North American continent, only opening our eyes to what the future may bring us in art, letters and wealth, and with zeal the latter may be kept in its proper relative position of handmaid to the other two. No nation not sunk in self-indulgence ever spent so much on attempts at beautifying daily life as citizens of the United States are spending today, and in it really lies one of our safeguards. Windows, elevators, stairways, areas, doors, are all of them in certain buildings fit places for ornamental metal, while bank interiors are hardly to be made safe for the employes and directors without metal screens and railings. Cornices, finials, balconies, fire-escapes, and even entire roof-gardens, may very properly be put into metal and metal shapes only. With the rapid spread of fireproofing for office buildings, we must expect to see many more pieces of fixed or portable furniture made of metal — and demands will be made not only that it shall be practical, but that it shall be good in design and execution. No window or door grille will be so considered, no matter how good its motif, that can not be swung open or got at for cleaning, and whose security when fastened can be successfully questioned, and so on, the practical generally coming first, as it must, and the beauty of the design taking second place. We have seen metal embedded in glass within the last few years to make it stronger and more fireproof, and the next step will be to make good designs, not necessarily more complicated, but more graceful and interesting than the woven galvanized iron-wire meshes now used. Then we can put it in plate glass in conspicuous places and secure strength, cleanliness and beauty in combination. Doors of wood are already protected by covering them with metal, and the practical has been so successfully attained in this direction that the next move to make the metal surface interesting in color will perhaps not be long delayed.

The Orientals obtain excellent surface and perforated decorations in metal by the use of acids and asphaltum or protective "resists." We have long tried it also in this country on an extensive scale, but owing, I believe, to the fact that we can not use the electric light in place of the sun for photography, it has failed to be commercially successful, and is employed now chiefly for making tablets and signs, in which work a dark day now and then does not interfere with the execution of the average design.

In speaking of the Latin races as the foremost workers in ornamental metal, of course it is not without due recognition of the often beautiful and always vigorous work of the Teutonic race. There is, however, often in German and Scandinavian work a lack of delicacy, of poetry and of repose which the Spanish and Italian has in such great measure. The German seems never to have been influenced so much by Eastern examples as the Latin was. This is made clear by comparing Asiatic and Indian work with some of the French or Venetian grilles. In some cases the patterns are almost identical. The railing of a balcony in a certain house in India is nearly the same as that of a grille in a mediæval church in central France, only treated in a far more interesting and graceful way in the Indian example.

Mr. Jackson, in his entertaining three volumes on "Dalmatia, the Quarnero and Istria," speaks of the beauty of the designs in metal on the east shores of the Adriatic, and gives good drawings of some church plate, until one wishes he had also photographed some of the simple iron grilles and other more ordinary forms which he found there. These must have been of more than ordinary merit, owing to the mingling of Venetian and Oriental characteristics observable in much of the architecture of these countries.

In southern Italy and in the east and north of Italy we find beautiful metal-work cast in small plates, in the bronze doors of the various churches, which were the work of Greeks or of their followers. One door at Ravello, above Amalfi, is extremely good, and the door of the cathedral at Verona is

DAMAS — COMBEAU DE LA FILLE DE MAHOMET.

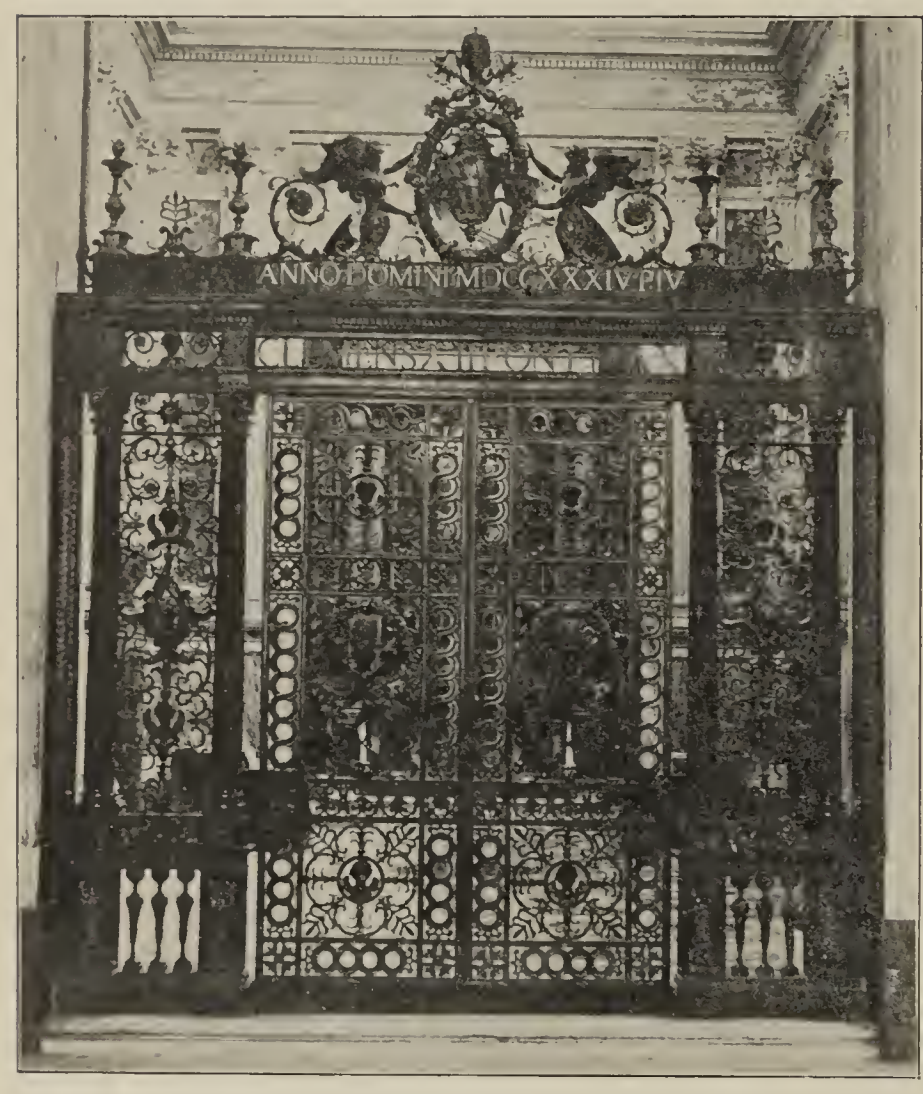
widely known and admired for its vigorous and decorative effects, obtained by raised surfaces in conjunction with perforations.

Here is an Oriental guard around the so-called tomb of Mahomet's daughter near Damascus — a conventional use of the sunflower being the motif — and, while it is curious, we should hardly like to see it used again in connection with a mortuary monument. In the Church of St. Apollinare, in

Classe, near Ravenno, the apse has in a crypt window a beautiful, though crude, grille which is ecclesiastical, though based on a classic design of imbrications or garden loops one over the other, filled in with the cross.

The little towns of Normandy and Brittany are full of good and simple specimens of balcony railings, and they are so common as to catch the eye at every turn in certain parts of the towns, encouraging one to hope that some day we shall see our own town windows and balconies furnished with equally good and useful protections, which are, at the same time, educational and pleasing to look at.

A word here about the excellence of much of the metal-work product today by American firms and individuals. We have all seen it improve wonderfully in character in the last ten years, rising from the cast-iron door grilles, of stock design, turned out by the iron foundry from a foreign book of patterns up to the thoughtful and well-studied examples executed now



ROMA — CANCELLO DELLA CAPPELLA CORSINI IN S. GIOVANNI IN LATERANO.

by specialists and often designed by architects who do not put off such details on the office boy along with tracing and blue-printing. We are, on the whole, in spite of much bad art in metal-work, making a great step forward, and as soon as we learn to forget our text-books and photographs, and think for ourselves on the basis of what these examples have taught us, we shall produce work worthy to endure.

If our designers would only remember that a bad thing done in metal is a long-lived reproach on account of its enduring quality, they would hesitate before sending out a sketch which may continually hurt, not only the public eye but the good name of its author. In this connection, a conversation on the train between two gentlemen who met by chance interested me. The elder, who had seen some years of service in the city government of Philadelphia, was bewailing to the younger man, an architect, the fact that while he was in the city employ years ago, and in a position to vote on the passage of an appropriation for building that public monstrosity known as the City Hall, he was unable to do anything to effectively head off appropriations, although he voted against it. "I consider it," said the elder man, "as a colossal mistake and of the most expensive kind." "Yes," said the architect, "and the worst of it is that such a pile is sure to last many years, if not for centuries."

Think of this, you to whom the delightful task is entrusted of doing a good, sensible, beautiful thing for the eyes of your daily business brother to see, that what is done in metal is also long-lived and should, therefore, even more than ordinary objects, be most thoughtfully and conscientiously designed. If you can not design metal-work full of the divine essence of genius, you can possibly at least make it inoffensive.

INTERIOR DECORATION.

BY JAMES WILLIAM PATTISON.

NOWADAYS men have no courage; only women are brave — that is, decoratively. Back in the seventeenth century, when Charles II., of good clothes and easy morals, lived, we are told by Samuel Pepys how both king and commoner decorated themselves. Mr. Pepys was well educated, and, being a commoner, had the good sense to hold office, not being born to rule. He wrote a diary all about the king and nobles, and actually kept his head. Now, from this diary we learn our lesson for today in the matter of interior decoration.

Men had courage in those days, and Pepys, as innocent as a boy and as joyous as a woman, tells all about his silk coats and scarlet garters, bows and flowing streamers. It seems that this commoner rejoiced in gay colors, but the king wore richer-toned gear; and we are like that in our interior decoration. Our diarist tells also of Nellie Gwynn, the actress — of how she once put on a cavalier's plumed broad beaver and looked very pretty in it — adding, "indeed she would look pretty in anything." Nellie must have been a rare bit of "ornamental structure." Even refined structural beauty may, it seems, be ornamented. So this pretty woman in the big hat that was not made for such as she raised that eternal question about when, how and how much we shall decorate.

An examination of many interiors in Chicago, with a view to studying artistic effect and the use of materials, brings us painfully in face of this question, "Is it of any use to decorate?" Looking at the halls of the Stock Exchange and the Board of Trade, both handsomely wrought and both neglected, we are tempted to say, "No," and would say it except for the fact that such good things, such serious efforts, each a good representative of an epoch in our art history, may lead to an improvement in our habits.

Chicago is so patriotic in its noble endurance of grime that it should at once dress its women in black and its halls in marble. Marble seems to get along comfortably with one of the principal products of Illinois. At the Board of Trade I was informed that the sixteen-year-old decorations have been cleaned but once, and that was seven years ago. When the decorations become of age and grow self-conscious they will no doubt wash oftener. Not much is to be expected of a child in his teens. It has been suggested that the delicate color decorations of the Stock Exchange could be easily cleaned but for the great cost of a scaffolding. But why? We can be as witty as other folks. I once saw in one of the big halls of the Louvre a tall tower of wood which was on rollers, and two men were up there cleaning or repairing. A section being completed, they got down and moved the affair along to a new spot. Also, one may imagine that the construction of the ceiling of the Board of Trade invites the laying of boards within easy reach of the dirt. It must be that we love the dirt because it is a Chicago product, else we would be rid of it. But as it is, we must use such material in decoration as will defy dirt, and this brings us to some limitations in our study. Back again to Mr. Pepys and his taste for cheaper and gaudier, we must compare paint with marble, cheap metal with bronze, painted ornament with

mosaic, for it seems as if we all must be kings and wear costly stuffs or else look frowsy.

All marble has "quality," as gold has quality. This element is indescribable but may be easily understandable when we say that ordinary painted surface has no quality or that brass has little and gold much. There is a tone and surface that is conveniently described as having "quality." Imitation marble has no quality. Look at the many examples of it; the mottled stuff is not even as like its original as "nearsilk" is like the real thing. Its only merit is that it will wash. Mr. Architect, do not frown at me for saying this. You would not use it except for the same reason that Mr. Pepys wore scarlet garters. His purse and taste and your patrons' are alike not royal. For yourselves you would use honest stone that has quality.

DECORATION, CHICAGO PUBLIC LIBRARY.
Shepley, Rutan & Coolidge, Architects.

Mexican onyx is sufficiently genuine and has a measure of quality. It is very suitable for certain interiors. In my lady's boudoir a very little would go a good way. But the onyx is far more respectable than the mottled composition, and it "keeps"—which the latter does not, but only grows dingy and still cheaper-looking in a few years. Then the composition is so easy and one can spread so many colors with it, just as Pepys could wear scarlet garters with bows and streamers to his vulgar heart's content.

There is an entry-way and stairs to an office building, all in white marble (gray-veined), but quietly varied by pilasters in very pale onyx. There are many similar entrances and stairs in all-white marble, relieved solely by paneling. These vast, expansive surfaces of this cold, silky stone are decidedly impressive; the quality in the goods tells. Indeed, there is a certain respectability, a royal air about the white that is denied the colored marbles. In going from the south entrance of the Public Library to the opposite end, one feels this. As to whether the warm-toned marble is like sunshine and the other like snow is not quite to the point. Sunshine on snow is certainly wonderfully impressive and carries us off our feet when summer sunshine would not stir us. The white is more regal. But it is a trifle deathly in tone; one might say saintly. Even the angels have pink wings, you know, along with their white array. What, then, shall be used to ease its puritanical perfection? Too much will certainly result in vulgarity. The king's silk may be embroidered with silk only, unless it be with gold. If the Parthenon and the Venus of Milo were originally painted, would that we might have been there to see. What could it have been like? Possibly M. Gérôme has solved the problem. His "Pygmalion," at the Columbian Exposition, two figures in very fine marble, was tinted very delicately, but not enough to destroy the "quality" in the marble. The flesh was faintly

IN CONGRESSIONAL LIBRARY.

flushed with warmth and the garment of Pygmalion took on a very delicate tint of greenish color, besides some quiet trimming in other tones. It was scarcely painted, but only stained. Could we do something like that, which had no cheapening effect upon the stone, great things might result. But even Gérôme missed it in his "Bellona," of marble and bronze in several tones. That was elegant and costly, but not noble. He went too far.

Bronze is certainly worthy of marble, and it may be toned to great variety and made very decorative. There is an endless field, as yet uncultivated, for an ingenious architect in this line. But he must have a fine color sense. Nothing is so kind to marble as gold, and it has been very judiciously used in Chicago. There are capitals entirely gilded or narrow panels in which some ornament occurs *rehaussé* with gold. Modestly administered, nothing could be better, but the gold must be fine metal. In the Congressional Library the somewhat too abundant gilding is of coin fineness and it will endure the centuries.

As regards combination of painted decoration with white marble the Washington library is a lesson to us. The great Stair Hall is one fine sweep of white marble, relieved only by the variety in the blocks and the abundant sculpture and carved ornament. This profuse carving changes the surface color slightly as well as enriching it. But on looking up to the vaults overhead one sees strange contrasts — contrasts of color, and, worse yet, contrasts of quality. Color contrasts are good, if harmonious, but contrasts of texture and quality are more difficult. Two sorts of silk may be put together, or silk and velvet are kind to each other, but silk and cotton on the same gown or the same wall make the gods angry. In Washington we have this contrast — silk in the marble and cotton in the painted decoration of the second-story vaults. The lower vaulting is mosaic, the upper is paint. One is quiet, being of the same quality as the marble, it is very harmonious; the other is garish, the work of workmen and not of artists, and it is cotton. Of course I do not mean the panels painted by skilled artists, but only the renaissance, painted ornament, done by men who worked for day's wages and not for love or glory. The "people" complain that the effect is garish, and quite rightly; our business is to determine why. It is not stated here that white marble and paint may not be placed together, but it is declared that in our present state of mural painting the effect is rarely good, and the reason is plain. Our artists can paint panels to match almost anything, but our journeymen can not do it. But even our artists find it difficult to unite paint with a silken surface like marble. There are other textures which do better. By the way, is it true that our Government could not afford to dress its fine library in as good stuffs as Charles II. dressed himself in? Must the Government put scarlet garters on the library as Mr. Pepys did upon his clothes? The Government employed Mr. Macmonnies to sculpture the stairway, and he did some work that makes us happy. If one would ask for more stately dignity in these sculptures, it may be answered that it is not well to question an art that is as true and good as that of Macmonnies. His talent runs to the sprightly, and it is a true, a real talent. Let us be thankful and content. Possibly the jolly figures — a bit flamboyant — are exactly in the spirit of the times, and if that be true do not try to saddle Greek formalism upon the nineteenth century. All these painted panels also show the peculiar spirit of the artists who made them, as they should. There are some better than others, but all are so good that criticism is disarmed.

Just a word about this painted decoration at Washington. What is said here is this: It is not a success as painting. The colors are too violent in any case and much too crude to stand in connection with the soft white of marble. Possibly better-guided workmen could have secured a better result. The artists' panels go with the surroundings well enough (though one questions even the panels), it is the conventional patterns that cry out because they are crude and because they are painty. It is the purpose here to declare that paint and marble is a difficult combination — possibly an impossible one. The divorce-court judge would have his sympathies so appealed to in this case of incompatibility that he would stretch the law in his effort to grant a decree. The mosaics in the lower vaults are perfectly in accord with the marble and can live with it until death do them part. Glass mosaic, as seen in the Chicago library, relieves wonderfully the frosty marble. The stair is quite uniform in whiteness while the blank walls are varied by dextrous minglings of various shades of marble. Not to express any opinion of my own, I may repeat those of many lay-people. The laymen complain on account of the sharpness of line in the stair mosaics, but do not find fault with the under-arches or the panels. The reason is easy to find — the panels and arches are just as brilliant, but in larger masses, and, therefore, less violent in effect. They do not declare war. But the "quality" of the two materials is the same and they walk hand-in-hand, neither one insults the other. The bronze is also a brother, and the fine stained glass in the dome keeps up the family aristocracy. The walls and mosaic are by a New York firm, but the glass is, I am told, a Chicago product. Certainly this glass is excellent, and we have firms here that could do the mosaic as well as the glass is done.

DECORATION, PROSCENIUM ARCH, AUDITORIUM, CHICAGO.
Adler & Sullivan, Architects.

There is excellent bronzework here and it proves itself of the same "quality" as the marble, the mosaic and the glass. Possibly our fine cast iron, bronzed, might come into this family.

If we keep on making sharp castings, this art will claim a right to shake hands with prince bronze. It is an imitation, but perhaps good enough to claim its rights as an original. Good cast iron is good enough.

To return to glass again. That we Americans have invented a new kind of glass decoration nobody can deny. The use of

DECORATION OF BOXES, AUDITORIUM, CHICAGO.
Adler & Sullivan, Architects.

new methods in any line is noteworthy, that our inventions should take an artistic bent is matter for congratulation because we are called scientific but not artistic. The new tones of glass that we have invented, the ingenious and beautiful combinations we make of them, the results of glass overlays and all the novel effects attempted, are matters which wake up our ancient teachers over the water. All this glass, however, must have its appropriate companionship. It is a material of all others elegant and needs princely neighbors. Painted stucco is shamed by it. Fine stone-work, bronze or gold or the best of choice woods are its proper society. There are some "enamel" paints that may claim comradeship also.

I know a church in Belgium—if memory serves right it is in Charleroi—where there is an interior richly supplied with the best of colored glass windows and also it is elaborately painted. It was reputed to be a refutation of the theory that colored glass could not be used with a painted interior. A visit to this church revealed worthy workmanship in both these mediums and the effect was not to be despised, but the painting was badly abused by its richer competitor and the theory was not disproved at all. Painted decoration, however good, had better keep away from good colored glass. If the Board of Trade ceiling could be given a "tubbing" oftener than once in seven years (or longer) we might judge of the matter right here in Chicago. As it is now, no one can tell by that hall. It is in glass and mosaic work that we have a success and that we do good things, and these combined with marble (which is better white or nearly so), gold, bronze or fine woods are the materials best suited to our soft-coal climate.

Other articles:

Moresque, *Inland Arch.*, Vol. III, No. 1. Walls and Ceilings, *Inland Arch.*, Vol. IV, p. 37. Interior Decoration, *Inland Arch.*, Vol. VII, p. 27. Mosaics, *Inland Arch.*, Vol. XI, p. 64.

RELATION OF THE ENGINEER TO ARCHITECTURE.

FORMERLY the architect was his own engineer, and not always a good one. This branch is not sufficiently emphasized in the architect's education, and some of the best architects call in the engineer when it comes to the practical work of engineering construction. The present tendency is toward a separation of the professions, the architect keeping strictly within the limits of his special training, and the engineer sticking closely to his figures. Yet there are not a few of the fraternity who believe that engineering is quite as properly a part of an architect's education as is drafting, and that the future will see some important additions to the curriculum in this respect in this country.

In the German technical schools they manage this matter quite differently. The architect is an engineer as well as a designer. He knows the strength of materials and the value of logarithms as thoroughly as his brother of the engineering school. He is not allowed to practice his profession without passing a rigid examination in the ordinary branches of an engineer's training. The result is that he becomes at the outset of his career an all-around man. Whether that fact tends to make him more or less successful as an architect we leave to the judgment of others. There is an opinion abroad that no man can have a too thorough training for his calling, and the tendency is toward enlarged rather than reduced courses in all the schools.

At least two instances of prominent Chicago architects who entered on a professional career as engineers might be adduced in this connection. These men found the drawing toward the artistic to be more powerful than the prosy pursuit of the practical, and they forsook engineering for architecture. Both have made noteworthy successes along the latter line, but both have been distinguished quite as much for their engineering as for their architectural skill. One is well known as the inventor of the steel-frame method of high-building construction, and the other is noted for his proven ability in solving great architectural problems where difficult engineering feats are prime factors. With both of these men the architect is great because he was preëminently an engineer.

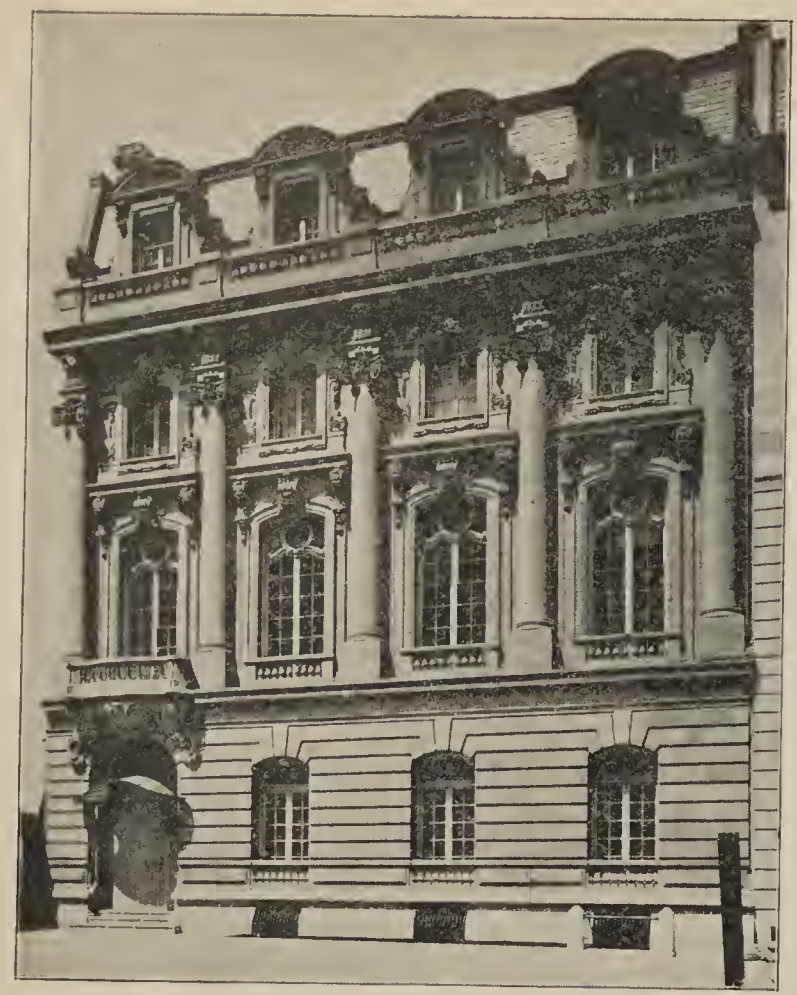
Yet the average architect often fails to combine the two spheres of action successfully. The architect is essentially a planner, a seeker after a combination of utility and beauty—the best possible arrangement of an office building commercially considered, together with a pleasing exterior and a rich and impressive interior. He can not always devote the needful time to the securing of all this, and at the same time immerse himself in the mass of figures and measurements that are essential to a safe and economical construction of the building from an engineering standpoint. So he associates with him in his work a practical engineer, evidently believing with our gallant Schley that "there is glory enough for all."

From foundation to roof the engineer must stand over the work almost literally day and night, rule and pencil in hand, to make sure that the eternal laws of physics are not violated, and that the mighty building shall not have been built in vain. His is a labor of vital importance.

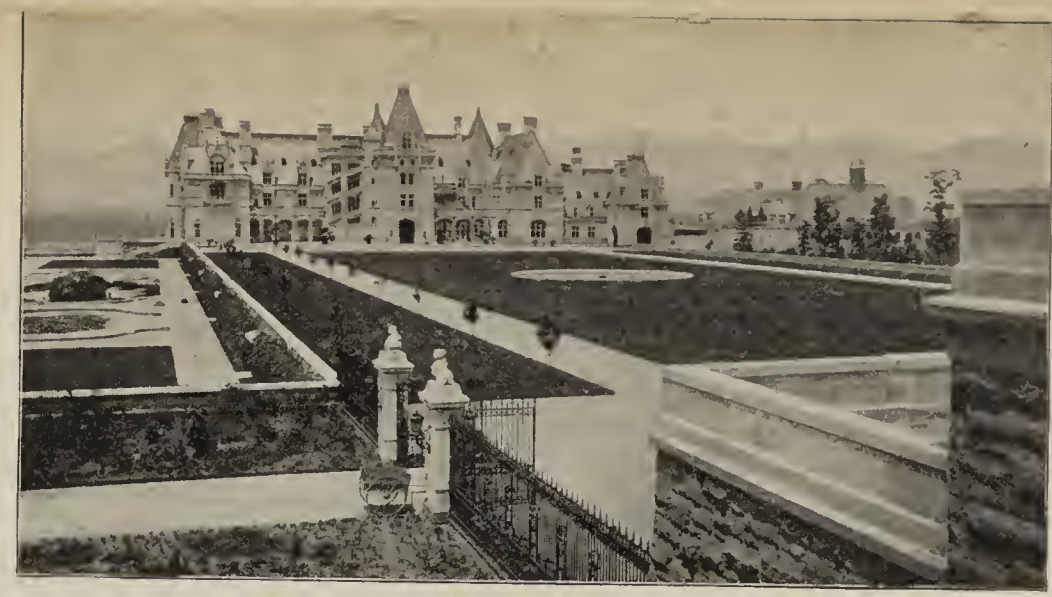
THE PLACE OF THE GENERAL CONTRACTOR.

ARCHITECT, engineer, superintendent and contractor—all are involved in the question, Shall the contract be let entire or in detail? The old plan, to parcel the work out to each of the several contractors and to manage them all from the architect's office through the medium of an active superintendent, is still adhered to faithfully by some architects in all their work, as they claim that they can get better results by giving their personal attention to each contract, but some of the architects of large work believe this plan has its limitations, and that while it may be all right for smaller buildings, like residences, it is not to be recommended for larger enterprises.

When an office building, or a large factory or warehouse, or a great flat building, is to be erected, this question becomes of prime importance, and it is then that the general contractor appears on the scene as a mediator between architect and workman whose value is recognized. He takes the contract entire

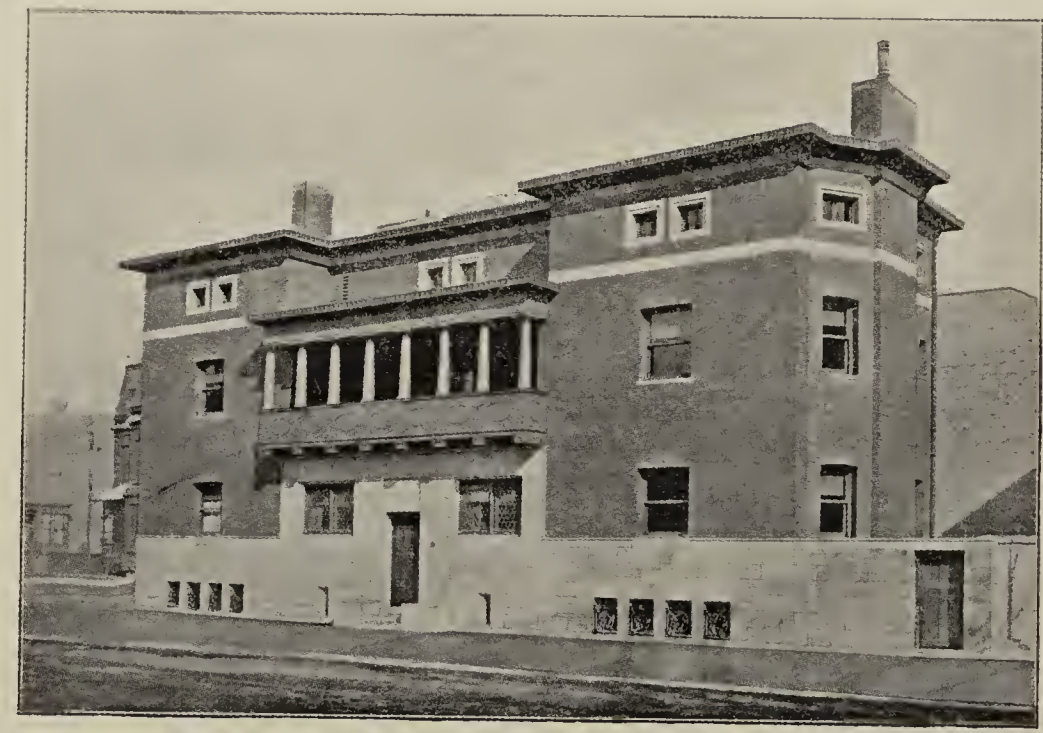


AT NEW YORK CITY.
Carrere & Hastings, Architects.



BILTMORE HOUSE, ASHEVILLE, N. C.—Richard M. Hunt, Architect.

AT WASHINGTON, D. C.
H. H. Richardson, Architect.



AT CHICAGO.—Adler & Sullivan, Architects.

AT NEW YORK CITY.
Kimball & Thompson, Architects.

AT SPRINGFIELD, MASS.—Bruce Price, Architect.

AT NEW YORK CITY.
McKim, Mead & White, Architects.

A GROUP OF RESIDENCES.

and is responsible for every detail of it. He gives ample bonds for the whole work, and shoulders the responsibility which otherwise would be divided up among two dozen or more smaller and perhaps less responsible contractors. If he is an enterprising and up-to-date contractor he employs a superintendent who is a practical engineer and who takes upon himself almost all the load of providing the proper material whenever needed; guarding against delays by keeping the several contractors moving in their regular order, one moving out of the way of another; inspecting and regulating the work from the standpoint of an engineer quite as much as of a superintendent. Such a man is valuable in smoothing over rough places in the busy architect's life and in reflecting credit on his employer, the general contractor.

VARNISH—ITS USE AS A FLOOR FINISH.

BY EUGENE M. POPE.

VARNISH-MAKING as an art was known to the ancients, and with them attained to some degree of perfection. It was practiced by the citizens of Pompeii and Herculaneum before the destruction of those cities, as is attested by the finding there of articles coated with varnish. It has been practiced also by the Chinese and the inhabitants of the East Indies from time immemorial. But only in the present century has it been brought to the highest degree of perfection, and this is due in large measure to the enterprise of American manufacturers.

The prime requisites of a good varnish are said to be four in number, as follows: It must dry rapidly and hard; it must retain enough elasticity when thoroughly dry to prevent cracking; it must preserve a smooth, even and hard surface; and it must adhere tenaciously to the material on which it is spread. These qualities are commonly attributed to the varnish itself, but they are quite as dependent upon the proper selection and application of the varnish by the workman. Varnishes are now made specially for all kinds and conditions of work, and they must be selected carefully, with reference to the particular requirements in hand. The surface to be covered must be carefully prepared also. Then the varnish may be applied with skill and care, and the work, if done well, will be enduring. But too often the work is not done well.

So great a variety of gums, dissolved either in spirits or oils, are used in the manufacture of varnishes that it is not possible for the architect or contractor to judge of the merits of a varnish by its name or its constituents, even though he were able to ascertain the latter; the usual and the better plan is to rely upon some responsible varnish manufacturer and to call him severely to account for failure, if any, of his goods to give the promised satisfaction. In general, it may be said that the use of common "resin" in the manufacture is likely to produce a varnish that will perish quickly—in other words, a cheap and undesirable product.

The most recent, and perhaps the most important application of varnish to architectural work is in the finishing of hardwood floors, the varnish used for this purpose being known as "Supremis Floor Finish." Almost from time immemorial the only finish known for a hardwood floor has been wax; in Europe no other is used, but in America a new departure has been made, and varnish is now considered the floor finish *par excellence*. Sixteen years ago this material was unknown in the architectural world; it is now universally known and used, and the only seeming drawback to its use is the supposed difficulty in removing the old wax finish from the floors. Methods of doing this are now in vogue and enable any one to perfectly remove all wax and to fit any floor for application of varnish.

The floor to be varnished must be thoroughly cleaned and then well filled, if a porous wood; but if a close-grained wood is used, the varnish must be directly applied, without the intervention of any other material whatever. Experience has shown that a varnish finish will wear better on floors, even on porous wood, without the use of any filler, the varnish being applied directly upon the wood; but there is some objection to this method on open-grain woods, in that the finish sinks into the pores and does not show so even a surface as appears when the wood is well filled. The durability of the finish, however, is greater when no filler is used.

The variety of ordinary uses to which varnish is applied, for interior and exterior finish, is familiar to the architectural world. It is coming into more and more general use as its advantages become better known. Its economy lies in the fact that it is so excellent a preservative of the work which it covers, and the secret of success in using it is in the care with which it is applied. Varnish is not a cheap material and should not be cheaply used. It should be applied intelligently and carefully, with special attention to the previous preparation of the wood, and when so handled it will give satisfaction.

FINE ART IN HOUSE PAINTING.

HOUSE painting has become in these latter days a fine art. The modern painter has need of knowledge and skill that his ancestors never dreamed of. The requirements of the architectural world and of the trade itself are growing in importance constantly and call for constant vigilance and enterprise on the part of the manufacturer. The time when a painter could succeed with the equipment of a few brushes and the ability to daub paint on a board has passed away forever. It has gone with the era of rough and ready manufacture, when spurious goods passed for genuine, and the paintmaker followed the old ruts because he did not know any better.

The average paint shop, however, is no longer a paint factory, for the painter is now content to leave the important matter of ingredients to the manufacturer, and he relies upon the latter to supply him with every variety of compounds for use in the trade. Beginning with wood fillers this variety runs the entire gamut of the painter's scale, including dry and water stains, surfacers, oil stains, japans, enamels, varnish removers, stain and paint removers, mixed paint, floor paint, roof, barn and bridge paint, bronzes, dry colors, white lead and oil—everything, in fact, the mere mention of all of which would be too much for our space. Even kalsomine is now sold ready mixed and is said to be better and cheaper than the painter-made variety. It is an age of short cuts, in this art as in all others.

The perfection of the art is seen in the manufacture of wood fillers and stains for furniture and interior finish. A good filler must fill thoroughly, dry very hard, rub off easily, be uniform in color, not given to settling, and as a result of these qualities will produce the very highest grade of work. Especially important is the clear, rich, uniform shade produced by the imported colors. A filler of this character has been brought out under the name of "Silex." Shellac has long been used for this purpose, but "Silex" is said to be superior to shellac and is cheaper. It costs less, works easier, covers better, costs less to thin, does not settle, brings out the color of the wood, dries dustproof immediately, and hardens perfectly, is easily sandpapered, and the manufacturers claim that it holds the varnish up better than anything else.

Another similar mixture is known as "Silaxer," which is a hard-drying surfacer, and is used as a liquid wood filler for close-grained wood and in place of shellac over a paste filler on hardwood, making a nonporous and perfect foundation for a finishing coat of varnish. "Silaxer" dries flat and will sandpaper without gumming; it may be used on fine work, as it contains no resin and will not crack varnish used over it. When desired, a stain is combined with the Silaxer, which is an economy both of stain and of the labor of applying it.

THE CENTURY'S TRIUMPH IN LIGHTING.

MODERN architecture is fundamentally utilitarian and commercial, admitting of only such an amount of ornamentation and relief as can be introduced without interfering with its particular purpose. The demand for light, for example, is one which pertains to commercial and residence architecture alike, and this demand has been met heretofore by artificial means almost entirely. With the introduction of windows came the use first of isinglass, paper, sea shells and other similar substances for window panes. Then came glass—not clear and translucent, but rough and cloudy; but the march of improvement has been steady, until at the present day it is as clear as crystal, admitting the bright sunlight almost perfectly.

So success breeds success, and one achievement leads to another. The same qualities of intellect and enterprise that accomplish one really notable deed are able to work out something still greater. It is this progression of events, all tending in one direction, that characterizes modern scientific or commercial enterprises when brilliantly successful. More daylight! more daylight! is the cry—from the man at the desk, from the salesman, from the great business-houses that have goods to show. And the cry goes on—away with artificial light as a substitute for daylight! away with dark rooms and offices on alleys and courts! And that same tireless brain of science says, here it is, and keeps on advancing until progress and science place in our hands the means of giving to the world just what it wants—more daylight. It is the Luxfer prism—word well chosen—*Lux*, light; *ferre*, to bear—light-bearing.

The far-sighted inventors of the Luxfer prism saw that if daylight could be thrown into dark places, and thus save the expense and annoyance of artificial light, it would be one of the most important architectural achievements of the century. Accordingly, they produced a small square of prismatic glass which was found to increase the light in dark interiors from two to ten fold. This apparently insignificant little piece of glass has become famous the world over, in the short space of

two years, as the Luxfer prism, and has opened up for itself a very wide and important field of usefulness. Every day suggests new possibilities for the prism, and hardly a week passes but some new adaptation of the glass is put to the test.

One of the first problems presented for solution was the lighting of dark basements. It was found that when prisms were placed in the sidewalk they lighted the front of the basement only. A vertical prism was then placed in the basement windows to gather up the rays of light from the sidewalk prisms, and project them to the farther end of the basement. This device, called the "Lucidux," was satisfactory, and at once it became possible in this way to make the darkest basement as light as day. No comment is needed on the possibilities thus opened up in the way of utilizing formerly dark and useless basements. In thousands of instances the Luxfer prisms may be so applied as to actually reclaim this otherwise waste space in important business structures.

Similarly in narrow streets or alleys, or in the lowest stories of light courts, where an insufficient exposure to the direct rays of light on vertical windows is had, the same principle is resorted to. A canopy of ornamental iron and prisms is projected above the window. The light, falling almost vertically, is caught on the canopy and thrown back into the room. Sometimes it is found desirable to use a "forilux," or vertical prism plate, projected a few inches in front of the window. The canopy, forilux and lucidux solve every problem of difficult lighting caused by overshadowing buildings or long and dark interiors.

Perfection of mechanical detail has been secured in the joining of the numerous small prisms that make up a single window, by the rapid electrolysis process, by which the small sections are first fitted into grooves in narrow strips of copper ribbon, the entire frame being then submitted to the rapid electrolysis process, which deposits more copper and fills up every crevice, making of the whole one solid piece. This construction admits of the maximum of strength and lightness, and is especially fitted for stained-glass work. It has been found to be fireproof also, and possesses far greater resistance to breakage than a single sheet of heavy plate glass. The importance of this fireproof quality can hardly be exaggerated. By this construction the most vulnerable portion of a building — the window — may be made proof against the ravages of fire. The dangerous and unsightly light shafts also may be dispensed with, as was done recently in the J. P. Ryerson building, in New York city, where a room 204 feet deep was perfectly lighted by Luxfer prisms placed in front and rear.

A more remarkable achievement was that of lighting the subcellar of the Metropolitan Life Insurance Company's new building in New York. This subcellar is twenty feet below the street level, yet by the introduction of the Luxfer prisms it is lighted perfectly, and the light so thoroughly diffused that no shadows are cast by the supporting columns. It is but one of many demonstrations of the wonderful possibilities in daylight lighting by use of the Luxfer prisms.

HOUSE MOVING AND SHORING.

HOUSE moving has been reduced to a science; the science of moving the largest and heaviest and most heterogeneous buildings in existence. Formerly it was thought that only some old tumble-down frame structure that had become a disgrace to the neighborhood was fit subject for removal, but now the better the house the better the deed, and no task, however complicated, is considered impossible. It might not be too improbable to believe that he who performed the gigantic task of moving a 6,650-ton church fifty feet down the boulevard, and raised it five feet and six inches, could remove the Great Pyramid from its present location to Chicago, to grace the next World's Fair, if a steamship large enough to carry it could be had.

The modus operandi of moving a monster building is somewhat as follows, the example taken being the church above mentioned: The walls were first thoroughly braced to prevent spreading. The load was raised on screws, and a track of steel rails resting on a floor of 12 by 12 inch timbers was laid under the building. The timbers covered the entire ground, and the rails (60-pound steel) were distributed three to five on a track with reference to the load to be carried. On these rails steel rollers were used, each 25 inches long and 2 inches in diameter. The upper surface of the rollers moved on Bessemer steel linings, ½ inch thick by 12 inches wide, cut in 2-foot lengths. Heavy timbers, inserted through openings in the foundation, supported the building on the rollers.

The problem of propelling the building along the tracks was solved by applying jack-screws to the beams on which the structure rested; the screws pushing against other similar beams which were held fast by heavy chains. Sixty screws were used, and each quarter turn of the screws (made simultaneously) advanced the building about one-eighth of an inch. This immense task of church moving is usually referred to whenever moving possibilities are discussed, but essentially the same principles are being employed in other everyday contracts of this kind. For example, a courthouse of brick and stone, 90 by 124 feet in size and with walls 4 feet thick, is being raised 11 feet to receive a new foundation. Another instance is that of a building, in which it was desired to reconstruct the interior and also the exterior up to the second floor. The entire building was shored up throughout, from bottom to top, and all posts, girders, etc., removed, all foundations rebuilt and new iron columns and steel girders put in place, the work being finished in the record-breaking time of twenty-one days.

A CONSIDERATION OF THE GAS QUESTION.

FROM time immemorial (i. e., gas time) gas meters have not been properly provided for in building planning. Frequently, if any provision at all has been made for them, it has been in a remote corner—usually in the basement—where their environment was spider webs, dust and rust, and their faithful "click" was lost to hearing on the murky air. Now a change is demanded. The gas companies have decreed it, and what the gas companies want they generally get. They insist that the gas meter is a legitimate part of the modern architectural scheme, and that it deserves a comfortable and accessible place in every building where gas is used. Accordingly, they ask architects to give due attention to this feature in future plans, and to add thereby to the sum total of happiness both of the meter man and the consumer.

Another and equally important reform is that demanded by Chicago gas inspectors relating to the location of shut-off cocks in buildings. The present custom often is to locate these valves at some distance within the building, where they are not readily accessible in case of fire. The result has been disastrous in many instances, many lives having been lost through gas explosions which might have been prevented had it been possible to shut off the gas from burning buildings. The new plan is to locate the shut-off valve outside the building, near the curb, and to cover it with plate glass, which may readily be broken by the firemen in case it becomes necessary to disconnect the mains from the house on short notice.

BUILDING SPECIALTIES.

THE MODERN ORNAMENTAL REGISTER.

Time has been when the register was, of all things architectural, the least ornamental, and was regarded as a sort of necessary evil and tolerated rather than welcomed by the architect who had a keen eye for the beautiful. This has all been changed in modern practice, the register of today being a very different article from its progenitor. It not only answers the purpose of heat or ventilation, to which it may be adapted, but is really an ornament as well, and is seriously considered in the general scheme of construction with a view to elegance and harmony. In other words, the register is capable of design and decoration in the highest degree.

This change has been brought about by enterprising manufacturers in two directions, namely, material and treatment. The ordinary cast-iron register labored under the disadvantage of being necessarily made of cumbersome castings to obtain the requisite volume of air capacity, and lacked the essential qualities of lightness, strength and beauty of design; hence a new and stronger metal was necessary to produce the desired results, and the ingenuity of American manufacturers proved equal to the occasion.

A practically new metal was evolved — a construction of iron and steel known as "Ferrosteel" — by the use of which was obtained the long-coveted advantages of increased air capacity of from ten to twenty per cent over ordinary cast-iron registers, lighter castings, greater strength by twenty to twenty-five per cent, and capacity for delicate and ornamental designs; so that now, when the architect wants his registers to conform to his own special designs he may have them, and they may be his exclusively if he so desires.

"Ferrosteel" produces castings of uniform smoothness, thereby permitting finishes of a new and varied character, such as electroplating in any desired color to harmonize with the varied finishes of hardware and decorations, in addition to the finishes with which the architect is familiar. Therefore, registers, ventilators, pedestal registers and screens made by the new process fulfill the most painstaking consideration of the architect in his designs for interior arrangement and decorations.

CHANGES IN THE LUMBER SUPPLY.

Hardwood interiors are likely to possess a rare value in the near future if the present scarcity of hardwoods continues.

Northern-grown hardwood is said to be rapidly disappearing, and the trade will soon be dependent almost wholly on southern forests for the supply. This applies particularly to red oak and white oak, maple, elm, basswood and birch, which have heretofore been found in large abundance in Wisconsin and other northern States. The scarcity has become so pronounced and prices have risen so much in consequence of it that several northern lumber firms have relocated in the South, where they find an abundance of red and white oak, satin walnut, cypress, poplar, sycamore, etc. This southward movement of the source of supply is one of the most significant factors in the present situation. Another is the successful competition of the Pacific coast forests with the East. Although 12,000 miles distant by water, they are sending fine lumber for interior finish by sailing vessel all the way "around the Horn," and selling the cargoes in Philadelphia in competition with eastern-grown lumber. Pine grown in the great lumber regions of the far Northwest is of a closer grain and admits of a finer polish than Southern or Eastern pine, and is of great durability. It is resawn in the forests of Columbia and Oregon, and shipped from there to Victoria, the nearest seaport. The Delaware river shipbuilders, who have contracts to finish the saloons of vessels with woods of high polish, and the builders of dwellings in which the same woods are extensively used, have been unable to find what they wanted anywhere in the East, and are compelled to look to the forests of the South and the far Northwest for their future supply.

In general, the lumber trade situation at present is one of great activity and rising prices, following a long period of dullness and depression heretofore unexampled.

THE ECONOMY OF PROMPT SIGNALING.

Economy in the operation of elevators in large buildings is as desirable as a good equipment. When cars are carelessly run, the service may cost double as much as it ought, and at the same time may be entirely unsatisfactory, both to the owner and the public. To insure absolute certainty in the making of stops is a most difficult task, since even with the best of numeral indicators passengers will neglect to call their floors in due time, with the consequence that the elevator passes the floor, and is compelled to stop and return, at an expense of time and power, which if repeated hundreds of times a day, is very costly. To simplify all this running, and to avoid this useless expense, the system of electric light signals has been devised and brought to perfection.

The general plan of this system is that of the electric light in both car and hall, giving warning to the passenger that a car is approaching, and to the conductor that the passenger awaits him; but there are several features of the perfected system.

At each floor landing two ordinary push contact buttons are neatly mounted on an ornamental block. These buttons are marked "up" and "down," and are normally open. The car signal consists of a small colored incandescent lamp, inclosed in an opalescent globe and ornamental holder. This lamp is illuminated when the car approaches within one floor of the one on which the operated button is located, and is automatically extinguished shortly after the car has left the floor. These features are adjustable. Should it be inconvenient to stop on receipt of this signal, the operator may push the normally closed circuit button, which prevents the operation of the signal for that particular car, but leaves the other intact. The next approaching car, however, will receive the signal.

On the landings before each elevator shaft are placed lights which indicate whether that particular car is going up or down. These lights are operated similarly to those in the cars, and give ample warning to the passenger as to which one of several cars will first reach his landing. In this system the signal to the car conductor is received only in the nearest up or down car approaching the landing at which the button has been operated. This avoids all possibility of confusion arising from several cars receiving the same signal.

NEW USES FOR GALVANIZED IRON.

New adaptations of galvanized iron are met with every day. Not the least of its advantages is that it is fireproof, and wherever it can be substituted for wood in construction it insures fireproof qualities in the building. With this end in view iron shutters were formerly used, and are still required under some conditions. Wired glass has been substituted and has been found to prevent effectually the spread of flames when interposed. But wired glass set in a wooden sash and surrounded by a wooden frame can not be regarded as the ideal fireproof window construction. Something more is needed, and is supplied in the latest adaptation of galvanized iron to architectural uses, namely, the iron window frame and sash.

The writer recently saw in a well-known Chicago factory what seemed to him to be a revelation of the useful qualities of galvanized iron as never before thought of. A complete window frame of the iron, with sash made of iron strips and glazed with wired glass, was the most effectual barrier to the spread of fire through an ordinary window that we had ever seen. The frame was adapted to be set in an arch of masonry, exactly as the wooden frame is set. It had all the good qualities of the wooden frame and was more enduring and absolutely noncombustible. The glass was held in place in the sash by means of iron strips; putty could be used but was not necessary. The wired glass was not transparent, but we were informed that a clear quality is now about to be put upon the market and that a transparent fireproof window is a certainty in the near future. The arrangement of the window stops was an ingenious reversal of the usual order, the sash being grooved, and the stop, consisting of a tenon, fitted closely to the inside of the frame. By the removal of the lower half of this tenon, which can be done instantly, the entire sash can be quickly taken out of the frame for cleaning or repairing. Altogether it was a most ingenious adaptation of galvanized-iron work to window construction.

AN INGENIOUS WINDOW-WASHING DEVICE.

The "bracket-rod" system of swinging windows is an innovation in window-cleaning practices that has come to stay. It all depends upon what is known as the "bracket rod," which is a hinged portable rod applied to the sash to be swung. This is practically all that is seen in operating the window. It is an ornamental fixture and is removed from the casing when the sash is returned to its normal position, so that the only parts that show are the small-headed studs, which are hardly noticeable.

The advantage of this device lies in the fact that it can be applied to old and new windows alike, without altering them materially, and at comparatively small expense. One pair of the bracket rods is usually sufficient for an entire building. Any style of window can be arranged to swing on them, and any size or weight of sash can be controlled by the rods by selecting a rod sufficiently heavy for the weight to be carried. It was somewhat of a novelty to see new and old windows, transoms and large stationary windows changed almost instantly into swinging windows and opened inward with perfect ease by applying the little bracketed rod to studs on sash and frame.

INVENTION APPLIED TO DETAILS IN HARDWARE.

A practical difficulty which is not uncommon in warehouses, where large openings require large doors and the side space is not sufficient to permit of sliding doors, has been overcome by a very ingenious invention which throws the door inward and upward to the ceiling, holding it there firmly and yet so evenly balanced as to permit of being easily brought down to earth again. No matter how heavy the door may be, it can be readily handled by one hand. As the lower edge of the door moves upward in the side grooves, the upper edge moves inward along the ceiling on side tracks, set at an angle of about twenty-five degrees, until the entire door rests, as it were, like a fly on the ceiling. To see an 800-pound door disappear in this way is somewhat startling. It looks as if the operator suddenly seized it and tossed it upward out of the way.

An all-steel, ball-bearing barn-door hanger is one of the latest improvements. It has hardened steel bearings, and twenty-two ¼-inch balls, and will hold any door weighing up to 500 pounds. This is a great improvement over the old style of wheel hangers. A similar device has been applied to show cases; it is known as the ball-bearing show-case door sheave, and is so arranged that the balls run directly on the track. It runs smoothly and does not wear out.

LATEST IMPROVEMENTS IN ROOFING FELT.

It was a novel but happy thought that brought out the screened gravel roofing, the idea underlying it being that a roofing felt having the gravel already in place would be a great economy of time, labor and material, and would give far better satisfaction than the old method of applying the felt first and then coating it with tar and gravel. This has proved to be the case in actual practice. This material is made up of a base of 15-pound asphalt felt, on which are placed two layers of Trinidad asphalt with burlap between, the whole being covered with screened gravel and then compressed between rollers to three-fourths the original thickness. The finished product is a heavy, solid and durable material for roofing purposes on either flat or pitched roofs, and which costs less for labor or material than the ordinary roofing.

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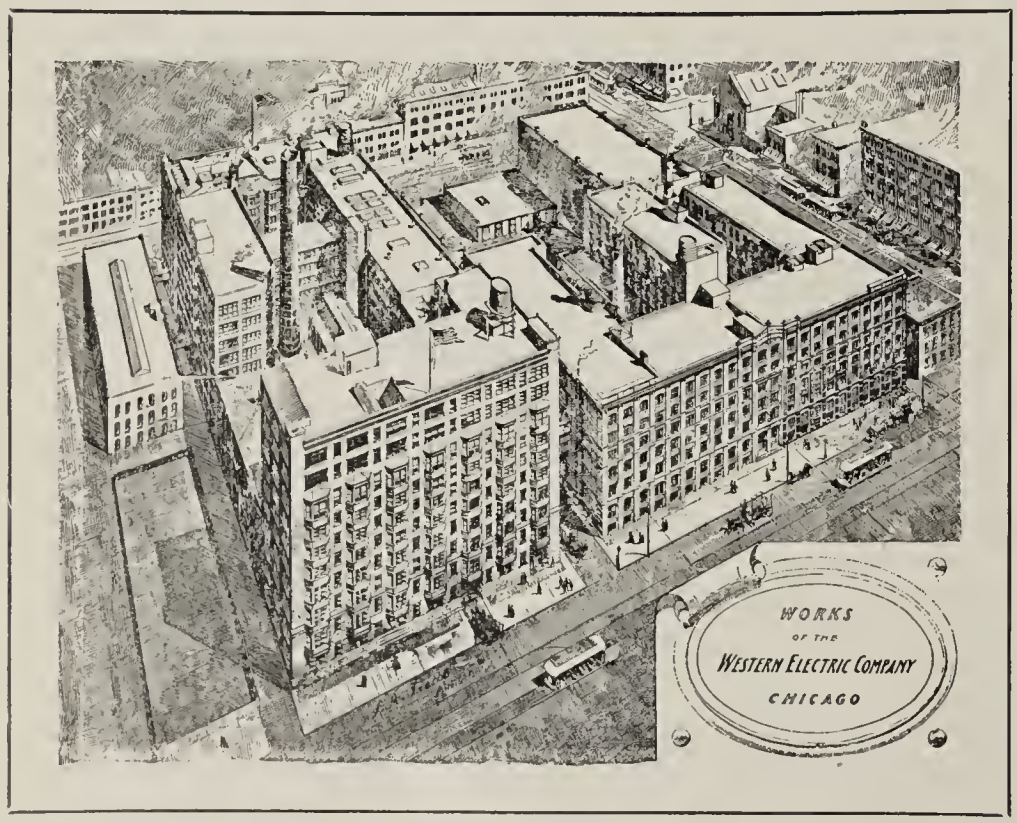

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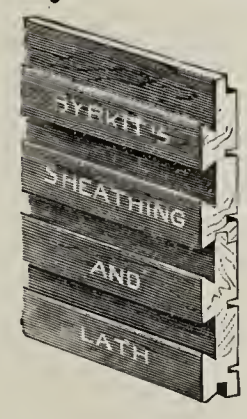

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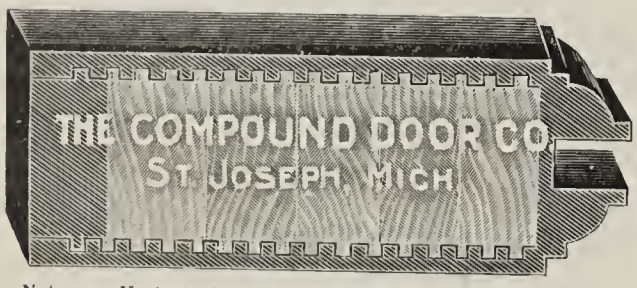

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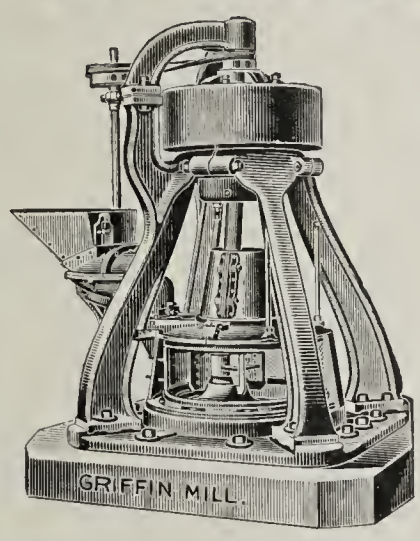

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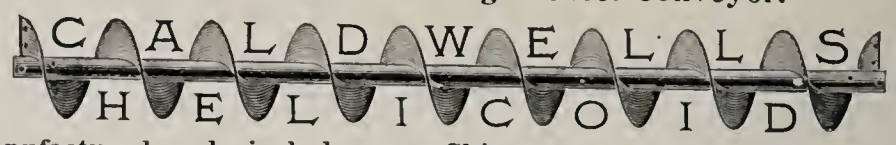

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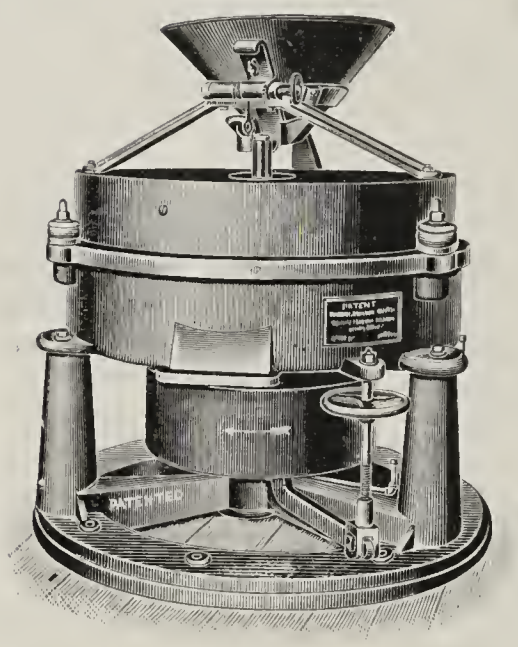

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CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

The next annual meeting of the International Mining Congress will be held at Milwaukee, Wis., June 19 to 23 inclusive. For information address T. J. Sullivan, secretary, 40 Sentinel Bldg., Milwaukee, Wis.

GROWTH OF CONCRETE CONSTRTCTION.

Few people realize the extraordinary growth of concrete construction in Europe, and how greatly it is now displacing the ordinary materials of construction, such as cut and dimension stone, brick, wood, slate. The modern fortifications of Europe are built of concrete and steel. We hear little of this class of work, from the fact that the military authorities guard their plans with jealous care as state secrets.

Hundreds of thousands of barrels of Portland cement have been consumed in a single modern fortress in Germany. The modern fortifications of Austria are constructed of concrete and steel on the Monier system, and almost every country on the face of the globe is adopting the same lines of construction for their national defenses.

The dry docks and harbors at Portsmouth, England, constructed for the use of the English Navy, under the supervision of the Admiralty Lords, consumed nearly 300,000 cubic yards of concrete, while the municipal authorities of the principal cities of England alone let contracts for municipal improvements to be done in concrete to the value of $20,000,000 in 1899.

Germany consumed about 13,000,000 barrels of Portland cement in 1899. When Portland cement becomes as cheap in the United States as it is in Europe we may expect an equally large consumption; then the manufacturer must be content with a reasonable margin of profit on the capital invested. While the American Portland cement producer has little or nothing to learn from the European manufacturer, we are still far behind Europe in the varied use of Portland cement.

We fully appreciate the use and economy of concrete where it is deposited with the shovel in rough-and-ready masonry. The use of the shovel at $1.50 per day worked against the trowel at $4.00 per day is only one of the items of economy in favor of concrete masonry as against stone or brick masonry. The shovel is usually worked ten hours per day, with sweat on the brow of the operator, as against eight hours per day for the trowel wielded under the eye and supervision of the walking delegate, who is a born enemy to honest perspiration during working hours. Legend and tradition unite in his mind to repress all exertion that might produce sweat on any member of the union under his jurisdiction.

The palaces and public buildings of Europe are using highly ornamented tile for floor and wainscott decoration, while the walls of the hospitals are being plastered with Portland cement mortar which can be washed down with the strongest acids to destroy disease germs, whereby the most perfect sanitary conditions are obtained, at the same time the fire resisting properties of such buildings are increased and insurance rates reduced.

Concrete construction is advancing along the lines of modern civilization giving greater returns for the capital invested, than by the employment of the usual materials of construction which it displaces.

BOOK ON THE SOUTHERN STATES.

The Southern Railway has issued a volume, 9 x 11 ins., under the title of "The Empire of the South," covering 200 pages, beautifully illustrated and printed in the highest style of art. The industrial resources of the states east of the Mississippi and south of the Ohio river and the winter resorts are fully described The work is at once a thorough and comprehensive handbook and guide of the territory covered. Cities, towns, hotels and resorts are minutely described and illustrated, portraying the various characteristics of Southern life and scenery. It is a veritable encyclopedia, well arranged and written in clear, lucid English. There is not a line of advertising matter in the volume. Copies may be had for 15 cents, the exact cost of mailing, by addressing J. C. Beam, Jr., Northwestern Passenger Agent, 80 Adams street, Chicago, Ill.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	DECEMBER.				TWELVE MONTHS ENDING DECEMBER.			
	1898.		1899.		1898.		1899	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	2,486,858	9,251	3,003,796	11,951	94,423,730	333,405	79,853,052	309,614
Belgium..	20,637,623	64,040	16,078,127	53,579	267,612,329	800,949	249,659,656	747,448
France	595,200	2,404	6,700	32	6,917,600	22,224	6,259,745	22,262
Germany.....	38,885,211	131,654	40,421,175	147,065	413,963,824	1,394,551	477,528,700	1,693,722
All Other Europe ...	598,200	1,952	803,600	2,984	20,695,270	64,180	27,269,463	71,676
British North Am...	25,670	140	43,750	200	1,909,670	8,852	1,759,190	8,808
Other Countries.....	.....	.....	140,000	683	5,200	67	955,500	4,696
TOTAL	63,228,762	209,441	60,502,148	216,494	805,527,623	2,624,228	843,285,306	2,858,286
Domestic Exports of Cements, bbls.	3,469	7,122	7,910	15,012	36,732	73,838	81,090	166,073

There were 2,425,389 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on December 30, 1898, valued at $7,664, against 676,342 lbs., valued at $2,282 in December, 1899.

Imports of asphaltum or bitumen for December, 1898, were 4,808 tons valued at $16,882; December, 1899—8,354 tons valued at $29,187. For twelve months ending December, 1898, 67,711 tons valued at $202,452, for twelve months ending December, 1899—100,168 tons valued at $319,089.

PROPOSED CANAL ROUTES ACROSS THE AMERICAN ISTHMUS.

(Continued from January.)

By THOMAS WRIGHT HURST.

As will have been seen the obstacles encountered were such as to decide the impracticability of these routes without continuing the surveys to the Pacific, and operations requiring time and money in any way affecting the general result."

CALEDONIA BAY OR DARIEN ROUTE.

This line runs from Caledonia Bay or Port Escosces on the Atlantic side to the Gulf of San Miguel on the Pacific side via the Savana river and has been advocated by Dr. Edward Cullen, F. R. G. S. Dr. Cullen remarks, in Society of Engineers (London, England,) Transactions, 1868:

"The length of the line is 42 English miles, for which at least 3 may be deducted for the winding of the Sucubti, which would be cut across. It runs 21 miles along the bed of that river, the lower twelve of which are pretty direct and would admit of being canalized by means of dams and embankments for a moderate outlay, leaving 27 miles for the length of canal required. The entire transit from sea to sea will then consist of:

	English miles.
Canal	27
Canalized river	12
Navigation of the Savana	16
Navigation of the Tuyra	3
Total	58

"The distance could be easily traversed in 24 hours, even making allowance for the time that would be occupied in the passage of the locks."

The only right place to start from (on the Atlantic side) is the western extremity of the Bight, northwest of Fulzencio Point, in latitude 8 deg. 53 min. 45 sec., longitude 77 deg. 43 min. 30 sec. By proceeding from thence a little more than one-half a mile to the west and then 2 English miles south the true entrance to the valley will be reached. The chief engineer in 1854 landed in Caledonia Bay 3 miles southeast of the above point and went up the Aglatumati, although Dr. Cullen had advised him to land at Caledonia harbor and told him that there was no pass from the Aglatumati. The best time for exploring the Isthmus is from the beginning of April, that being the dry season. The rivers are then low and the heat is tempered by a northeast breeze. The party should arrive in Darien on or before the first of December. The immediate desideratum is a detailed survey of the line. Its entire length being 39 miles, this may be accomplished by a few engineers in three months.

Dr. McDermott of H. M. S. Espiegle, Dr. Brownlow of the U. S. Corvette Cyane, Dr. Rondat of the French war steamer Chimere (avis) and Dr. Ross of H. M. S. Virago, show that amongst 900 men who composed the crews of the vessels which lay at anchor in Caledonia harbor and 250 men of the Virago, which was stationed in the River Savana in 1854, not a single case of sickness occurred during their stay, whilst the convalescense of those who were sick on the arrival of the vessels there was unusually rapid.

The elevation of the highest ridge to cross is estimated by Dr. Cullen at from 180 to 200 feet.

Commander Selfridge, U. S. N., in his report, page 96, also states: "Caledonia Bay contains four distinct harbors, viz., Sassardi Bay, Grant Harbor, Caledonia Harbor and Escosces Harbor (on the Atlantic side). All of these are commodious and comparatively easy of access and contain plenty of water for vessels of any size with good holding ground."

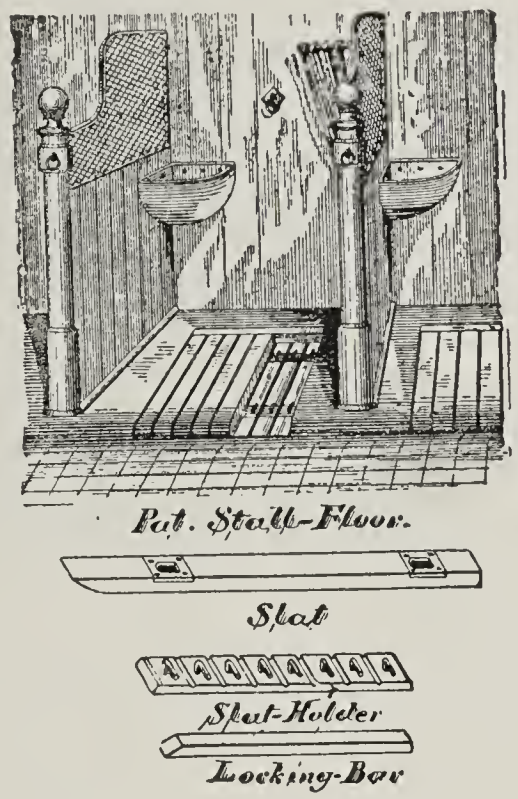
Commander Selfridge states in his report: "This route starting from Caledonia Bay proceeds westward to the vicinity of the junction of the Sucubti and Chucunaqua, thence to the junction of the Lara and Savana and down to the Pacific. Its noble harbors and the assertions of Dr. Cullen, but partially contradicted by the meagre reports of Gisborne and Strain, required that this route should be surveyed. The result of the survey fully corroborates all the previous reports of the adaptability of the Savana river for canal purposes as well as Darien harbor (on the Pacific side) answering every requirement for the terminus of a canal, but unfortunately the delineations of the interior of the isthmus on the Darien line will never call them into use in connection with the latter."

However, Dr. Edward Cullen, F. R. G. S., who professes to have explored this region, considered a canal quite practicable here. He also tells us it was reported that the evening field gun at the Spanish Fort Carolina (on the Atlantic side) could be heard at Principe (on the Pacific side). There is also much to encourage us that a canal might be constructed on or near this line in the exploration of Commander Prevost, R. N., also the exploration of Dr. H. C. Caldwell of the United States Frigate Independence and official report of Milla's Journey in March, 1788. Translation (see "Isthmus of Darien Ship Canal," by Dr. Cullen, and also a work compiled by me from various authorities entitled, "Isthmus of Panama, Nicaragua, Canal Route," etc.)

THE END.

CONCRETE STALL FLOOR.

The illustration shows a new and improved stall floor, consisting of a concrete base and sides, with removable wooden slats covering the space upon which a horse usually stands. The slats are anchored to bed-plates, or slat-holders, carrying a series of hooks pointing toward the head of the stall. Each slat is mortised at two points to receive the hooks. When all the slats are laid in position an



open space remains between the ends of the slats and the head of the stall; this is fitted in with a locking-bar, as shown in the cut. More than 2,500 of these stalls have been built in New Jersey by W. W. Schouler, of Newark, N. J., the inventor and patentee of this stall. The price for single stall is $10, and $20 for box stalls, f. o. b. The patentee publishes an illustrated catalogue for circulation, to be had on application.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

Mexican capitalists controlling oil lands on the Pacific coast yielding heavy lubricating and fuel oils are about to commence active operations on a large scale. The product is not suitable for illuminating purposes.

NATURAL CEMENT CONCRETE BUILDINGS.

We illustrate four specimens of monolithic concrete construction for barns, basement walls and business blocks out of natural hydraulic cement erected in Ontario and Manitoba.

Fig. 1.—Concrete Barn under construction at Brandon, Man.

Fig. 1 shows a barn under construction at Brandon, Manitoba. The dimensions are: Ground plan, 30x40 feet and 14 feet from the ground to the peak. The walls are 12 inches thick to the plate, and the gable walls 8 inches thick.

Fig. 2 is a business block built for T. F. Patterson at Britle, Manitoba. The ground floor area is 52½x70 feet and 44 feet high. The basement is of stone excavated from the cellar area and was under contract before cement was considered for the remaining three stories. The walls of the first story are 13 feet high and 12 inches thick. The second story is 10½ feet high and 10 inches thick. The third story is likewise 10½ feet high and the walls are 8 inches thick. The building was erected under the supervision of Mr. N. B. Hagar, the agent of the manufacturer of the cement used.

Fig. 3 shows a concrete basement carrying a wooden frame of a dairy and stock barn erected near London, Ont, by Mr. J. A. James. The walls average 12 feet high on the outside, inclosing an area 72x60 feet. One hundred barrels of natural hydraulic cement and 150 loads of gravel and an unmeasured quantity of small boulders were used. The floors throughout are concrete as well as the mangers and gutters. It was built by four men in eighteen days.

Fig. 4 is a concrete basement barn 54x100 feet and 9 feet high erected by the Hon. T. L. Pardo, M.P.P. Two hundred barrels of hydraulic cement were used in the concrete. The work was done under the supervision of Marcus A. Ware, traveling agent of the construction department of the estate of John Battle, manufacturer of Thorold hydraulic cement of Thorold, Ont., who are teaching the people of Ontario and Manitoba the use and value of concrete contruction. The specimens of works herein illustrated were all constructed under the above named company's enterprise and supervision.

The Iola Portland cement plant is constructing a cement water tank 50 feet in diameter and 40 feet high on elevated ground near the works, connected by a pipe line from the river, through which water will be pumped into the tank. The head of water in the tank will be sufficient to throw a stream of water on any part of the buildings.

Fig 2.—Concrete Business Block under construction at Britle, Man.

The Chicago Veneer company has constructed a concrete tank 35x20 feet by 10 feet deep for treating logs with steam to soften the fiber of the wood to enable the knives to shave it into veneer.

TESTS OF THE CONSISTENCY VOLUME OF PORTLAND CEMENT.—I.

(From the Engineering Record.)

Nine years ago the Society of German Portland Cement Manufacturers passed a series of resolutions to the effect that accelerated tests for determining the soundness (constancy of volume) of Portland cements do not afford reliable grounds for judgment of the value of such materials in actual use. It was declared that Portland cements which do not pass these tests prove entirely sound in service. These resolutions were criticised unfavorably by Messrs. von Tetmajer, Bauschinger, Michaelis and finally C. Prussing, who held that the standard tests of the society were insufficient, particularly when the cement must harden in the air. In February, 1894, the last-named gentleman read a long paper on the subject, which closed substantially as follows:

1. The standard test for the soundness of cement is no longer to be considered satisfactory. There is not sufficient security furnished consumers that cements which are tested merely by the present standards and found good can be actually handled in the usual methods of to-day.

2. Two compressed cakes which have remained hard and completely free from warping and cracks after setting 27 days, one in cold and the other in hot water at 90 degrees Centigrade, furnish proof that the cement used in them will withstand all proper demands for soundness.

3. It is desirable that, as an accelerated test for soundness, there should be included in the society's standard series, the compressed cake test of samples, hardened 24 hours, in hot water of 90 degrees Centigrade.

4. As slow-setting cements should be designated only such as remain entirely unchanged for at least two hours after they are made into mortar at the standard temperature and of the standard mortar consistency.

That is, the process of setting must not have begun within that period.

5. It is not right to consider a slow-setting cement as suspicious because it shows an appreciable increase in temperature while setting, for there are a number of excellent slow-setting cements which begin to set only after five to six hours, and finish that action completely in an hour, in which time an increase of 5 to 7 degrees Centigrade is often shown. Such cements, provided they pass the compressed cake tests, are generally better than others which begin to set within 30 to 60 minutes and finish it in 7 hours, and show no increase in temperature during the prolonged process of setting.

6. It is not right to judge of the quality of a Portland cement merely from tensile test briquettes which have set 28 days in cold water. The quality should rather be measured by the results of compressive tests with pieces which have set 7 or 14 days and 28 days in cold water.

After some debate, the society determined to entrust to a commission the following problem: Does the standard test furnish true knowledge of the soundness of Portland cement in practical use or does one of the accelerated tests supply this information in a satisfactory manner?

The commission spent several months in preparing a program for the investigation, and during this time it also joined forces with the Royal Mechanical Testing Laboratory at Charlottenberg, where the facilities for testing building materials are unusually complete. Mr. Max Gary represented the laboratory in the work, and he has recently written a valuable monograph on the subject, from which the following notes are abridged:

After the plan of procedure had been approved, an invitation was sent to all the members of the society asking them to send, under conditions affording entire secrecy, a ton of cement which would not pass the boiling test, although satisfactory in practical use. As a result of this request the following ten cements of this nature were received, their character being indicated by the senders.

A. A South German cement well suited for concrete and slabs.

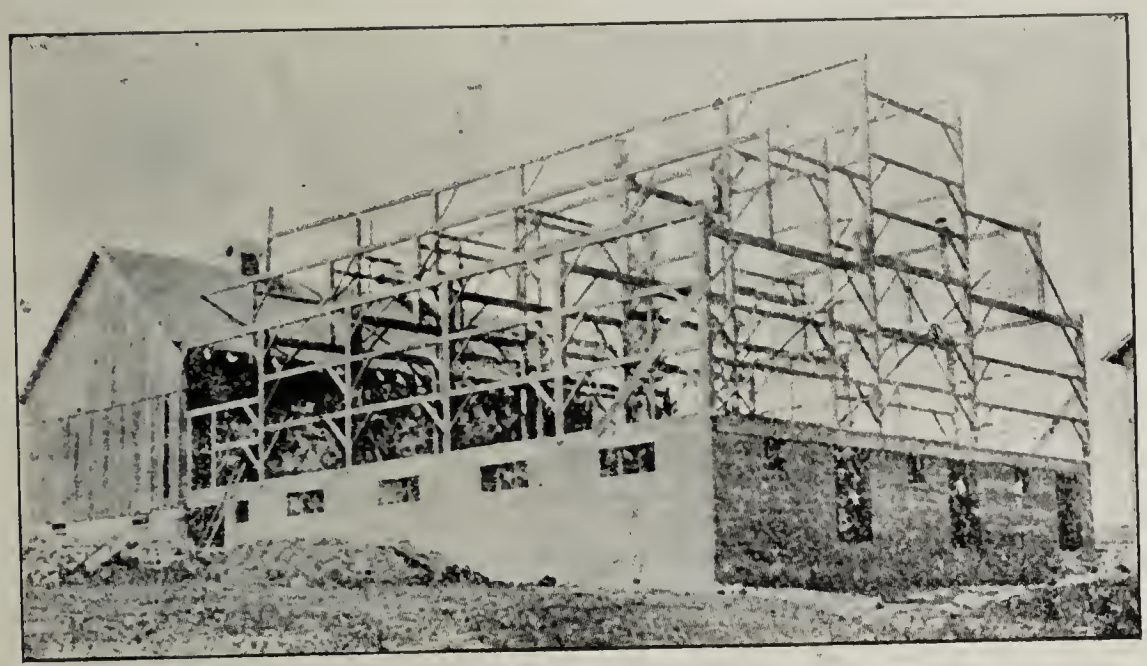


Fig. 3.—Concrete Basement of Stock and Dairy Barn, near London, Ont.

B. A Central German cement, not otherwise designated.

C. A North German cement. Samples were from a grinding of two days which gave bad boiling tests. The pats warped somewhat, showed marked checking, and were very soft after boiling nearly three hours, although firmer after a few hours in the air. The balls made at the same time showed only a single fine hair crack with two short fine branches. The pats were made of 100 grams of cement at about 20 degrees Centigrade, with 27½ per cent of water, and were placed at once in a damp chamber. After about 19 hours, they were placed for 1½ hours in steam and then for the same period in boiling water. The balls were made of 200 grams of cement with 10 per cent of water and pressed very firmly in order to fill the voids with cement as much as possible. They were likewise protected from evaporation in the damp chamber, and after remaining there for 19 or 20 hours were placed in a very hot spirit flame without the intervention of wire netting or a plate. Balls with 18 to 20 per cent of water were rejected as too soft at the works. Water and air tests were good. The ultimate tensile strength at 7 days was found at the works to be 10 to 17½ kilos per square centimeter, and 19 to 21½ kilos at 28 days. Grindings which were found to be doubtful were not sent from the works, but used there for concrete and for floating a water basin. They were used for other purposes also, and proved entirely firm and free from cracks, even when employed at a time when frost began to occur at night.

D. A slow-setting cement from South Germany, ground on December 19, 1895. Time of setting, nine hours, with the cement at 9 degrees Centigrade, the water at 10 degrees, and the use of 24 per cent of water in preparing the sample. The cement passed the standard and warm-water tests up to 75 degrees Centigrade, but not the boiling test, and was entirely satisfactory in use, so far as the makers knew.

F. A South German cement, which the makers said would not fully pass the boiling test, but behaved well in use.

G. A West German cement, which the makers thought, did not pass the boiling test, but did well in practical work.

H. Cement from Austria-Hungary. ball mills. It is said to rarely pass

J. A cement from Austria made from dry pressed bricks ground in the boiling test when fresh, but has been used for years without complaint.

L. A South German cement which, the makers state, loses its property of swelling by long storage.

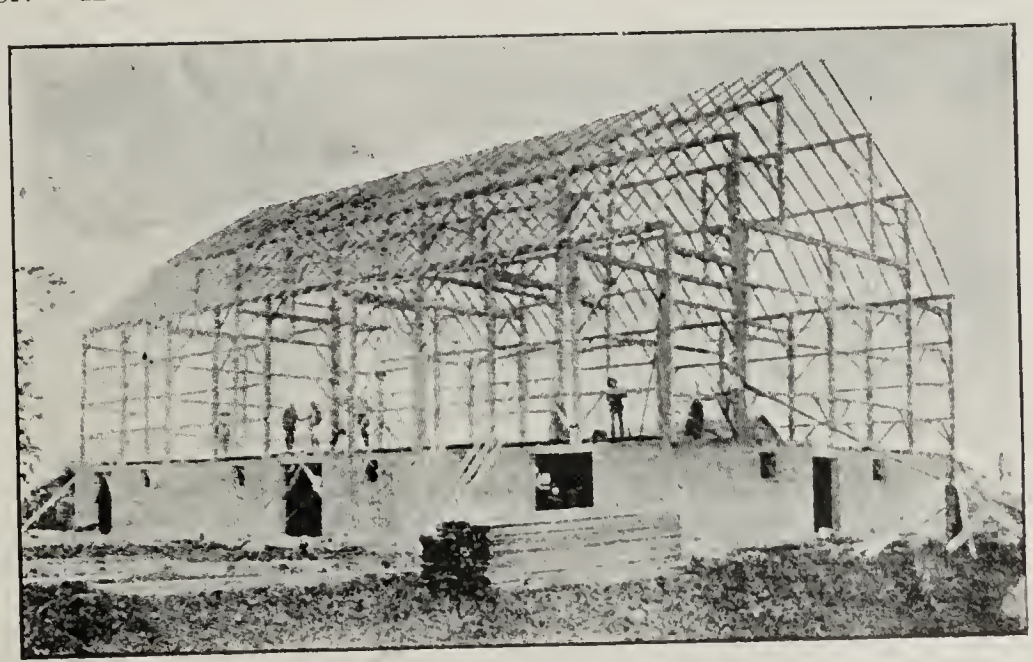


Fig. 4.—Concrete Basement of Barn on Farm of Hon. T. L. Pardo, M.P.P., Cedar Springs, Ont.

N. Cement from South Germany, which is made by grinding clinker fresh from a ring kiln and is packed as it comes from the mill. The cement reached the laboratory on April 7, 1896, and should, according to the makers, pass the boiling test from four to six weeks later. Repeated prolonged experiments have convinced the makers that the fresh cement which does not pass the boiling test behaves well in use and has good strength.

As soon as possible after the receipt of these cements, they were submitted to tests in the laboratory. The portion of each cement not used there was divided into two portions of 50 kilos each, put in soldered tins and sent to two members of the commission, and the remainder was sent to Messrs. Dyckerhoff & Widmann for the preparation of cement wares to be exposed to the weather. When each sample was sent, attention was called to the importance of beginning the tests immediately and keeping the cement in a tightly closed vessel. The Rhine sand for the tests was sent to the members by the chairman of the commission, Dr. Schumann of Amoeneburg, while each member prepared the standard sand for himself.

The usual methods were observed at the laboratory in preparing the samples and conducting the tests, but Mr. Gary was not informed concerning the conduct of the tests elsewhere, save it conformed with the standards. A number of outside circumstances, particularly the fact that the testing of the cements was not begun everywhere as soon as they were received, caused in some cases great differences in the results. The same weight is not to be given to all the experimental results, nevertheless the collective result gives the intended general view of the behavior of the cements under the different tests.

The test for time of setting was made with pats on glass plates and in hard rubber cells into which the cement, wet according to the standard procedure, was filled. The pats were considered set when no mark was apparent after light pressure with the finger nail or a Vicat needle of 1 square millimeter section had been placed lightly on them. The cement to be tested and the water to be used in preparing the pats were left over night in the setting room before the experiments. The temperature of the air and water and the moisture in the air were determined before each test was commenced.

The regular sieves in the testing laboratory were used in determining the fineness. The sifting was prolonged each time until no more particles of cement passed through the meshes. In order to break up the little lumps which often occur from slight moisture, two or three stone marbles were placed on the sieves.

For the soundness tests the following pieces were prepared from each cement:

1. For the standard and air tests: *a* Sixteen pats of 100 grams of cement each, 10 centimeters in diameter, and 1 centimeter thick in the middle, thinning away to the circumference. *b* Sixteen pats of a similar form with rounded edges, which were left 24 hours in damp air and afterward (1) three days in water and then in air, or (2) in the air of the room, or (3) in the free air, under a roof.

2. For the drying test at 100 degrees Centigrade, four pats like those under 1.

3. For the Heintzel ball (glow) test, four balls of about 5 centimeters diameter.

4. For the Michaelis boiling test, four pats as in 1, and, if necessary, four similar pats of 1, 2, 3 and 4 weeks' period of hardening.

5. For the Tetmajer ball boiling test, four balls of about 5 centimeters diameter.

6. For the Maclay hot-water test, six pats of about 8 centimeters diameter and $1\frac{1}{2}$ centimeters thickness made on glass plates.

7. For the Prussing compressed cake test (pressure 50 kilos per square centimeter), four cakes with 5 to 8 per cent water, of about 8 centimeters diameter and 1 centimeter thickness.

The amounts of water used in preparing the different samples for testing were chosen to correspond with the nature of the cement. As a general thing, the pats for tests 1, 2, 4 and 6 were made with the same amount of water, varying from 24 to 27 per cent with the different cements. The water addition for the Tetmajer balls was somewhat less, varying between 22 and $26\frac{1}{2}$ per cent. It was still less for the balls for the Heintzel glow test and varied between 21 and 26.5 per cent. The compressed cakes were made with 7 or 8 per cent of water.

The following rules governed the conduct of the tests and the interpretation of the results:

The drying test at 100 degrees centigrade.—One hundred grams of cement were mixed with water in the standard manner, and formed into a pat on damp blotting paper laid on a smooth glass or metal plate. After setting and the removal of the paper the pat was kept for 24 hours in damp air and dried at 100 degrees Centigrade on a metal plate in an air bath heated by boiling water, until no more steam was given off, a process lasting about three hours.

2. The Heintzel ball test.—Three hundred grams of cement and 60 cubic centimeters of water were quickly worked together and formed by hand into a ball. The right quantity of water was attained when the cement seemed somewhat greasy on rubbing the ball and the latter yielded slightly to pressure. With cements of average quick-setting character and those needing over 30 per cent of water to make pats, 61, 62 and 63 cubic centimeters of water were taken to make the balls. It was found by experience with these particular cements that even 21 per cent of water was not enough in most cases. The balls were laid on a glass plate, and after about five minutes became so hard that the finger nail left hardly any impression. They were then placed on thin sheet iron and heated over a Bunsen burner. The point of the flame was not allowed to reach the iron at first, for if the heating was too quick little flakes were thrown off the ball by the escaping steam at the places heated most strongly. As soon as the ball began to become dry where it rested on the plate, the flame was gradually raised until finally, at the end of about half an hour, it lapped the whole plate. Two hours later steam was no longer condensed on a glass plate held close over the ball, and the test was ended. An increase in the heat until the ball glowed was not contemplated.

3. The Michaelis boiling test.—Fifty grams of the cement to be tested was mixed to an approximately normal consistency, that is to say, with 13 to 15 grams of water, worked over for a minute and then made into a pat 1 centimeter thick in the middle and thinning toward the edges, on a glass plate. The pat was left to harden for 24 hours in a room having an atmosphere at the point of saturation, and then placed, either with or without the glass plate, in a bath of cold water which was brought to the boiling point slowly, in about 10 minutes, preferably with the cover on the bath. The pat was entirely covered by water. In case it was necessary to add water, this was done in small quantities so as not to check the boiling except momentarily. After boiling for three hours, the pat was taken from the water and examined.

4. The Tetmajer ball boiling test.—A stiff paste of cement and water was made into balls of about 5 centimeters diameter. Its consistency was such that a ball resting on a glass plate could be changed into a round cake without cracking by pressing or striking it with the hand. The

balls were kept 24 hours in a damp room, then placed in a bath of cold water, which was slowly, in about 1¼ hours, brought to the boiling point. The test was finished after six hours of boiling.

5. The Maclay hot water test.—Six cakes about half an inch and 3 inches in diameter, made of neat cement and water and of the same consistency as briquettes for tension tests, were prepared on thin glass plates. One of these was placed as soon as made in a steam bath of 90 to 95 degrees Centigrade. The second cake was placed in the same steam bath as soon as it had set and could support the standard American needle loaded with a weight of 1 pound, while the third cake was left double the setting time before it was placed in the bath. The fourth cake was allowed to harden 24 hours before being placed in the steam bath. The fifth was placed in fresh water of about 15 degres Centigrade. Each of the first four cakes remained 3 hours in the steam bath, were then left 21 hours in boiling water, and finally taken out and tested.

6. The Prussing compressed cake test.—One hundred grams of Portland cement were thoroughly mixed with 5 to 8 per cent of water, according to the fineness of the grinding. It was then uniformly spread in a mold, placed under a ram and subjected to a pressure of 50 atmospheres. Two cakes made in this way were taken at once from the molds and allowed to harden for 24 hours on glass or iron plates, precautions being taken to prevent evaporation. Both cakes were then placed in cold water, where one of them remained for 28 hours. The second compressed cake, which was to be subjected to an accelerated test for soundness, was taken from the cold water after two hours, and, in case it was still without defect, was then placed in a water bath of 90 to 100 degrees Centigrade. If this cake was entirely even and free from cracks after a four-hour submersion in the hot water, then the cement was generally to be considered sound, that is, of unchanging volume, according to the originator of the test. If the cake was even and free from cracks after 24 hours in the hot water, the cement was certainly sound under the hardest conditions of mixing and use. If the cakes also showed, after 24 hours in the hot water, a particularly good strength, that was a sign that the quality of the cement was, in respect to strength, especially good.

For tests of the change in length by means of the Bauschinger apparatus, pieces 10 centimeters long and 5 square centimeters in cross section were used. They were provided at first with little nickel plates at the ends, which were later replaced by agate plates. The test pieces of neat cement were made with 20 to 22 per cent water, and each of those of 1 part of cement to 3 parts of Rhine sand were mixed with 10 per cent of water. The measuring of the test pieces, after one day in the air and the remaining time in water, was made after the expiration of periods of 24 hours, 28 days, one and two years, respectively, with the Bauschinger calipering apparatus.

The mixing of the mortar as well as the prepartion of the test pieces was conducted according to the directions in the society's standards. The test pieces of 1 part of cement and 3 parts of sand, either normal or Rhine, were made with the Boehme hammer, while those equal parts of cement and sand were formed by hand with a 750-gram spatula. The amount of water added for normal sand, 1 to 3 test pieces was 10 per cent; Rhine sand, 1 to 1 pieces, 12 per cent; Rhine sand, 1 to 3 pieces, 10 per cent. The tension tests were made in a Michaelis lever apparatus; the compression tests in an Amsler 32-ton press.

For the tests of the weathering properties of the ten brands of cement, the firm of Dyckerhoff & Widmann of Amoeneburg prepared from the samples as soon as they were received two medallions 29.5 centimeters in diameter and 3 centimeters in thickness at the edge, two rosettes 24.5 centimeters in diameter and 5 centimeters in thickness at the edge, and two sewer pipe caps of 21 centimeters diameter and 3 centimeters thickness at the rim. All were made in plaster of paris or clay molds with a so-called preliminary pouring of equal parts by measure of cement and fine Rhine sand, an after-pouring of 1 part of cement and 2 parts of coarse Rhine sand, and finally a filling of rammed mortar of 1 part cement and 4 parts of gravel-sand. One piece of each set remained in a damp, closed room 3 days, and the others 28 days before being placed in the open air.

[TO BE CONTINUED.]

Alderman Gohlke of Kankakee, Ill., gives the estimate cost for a cement bridge now under consideration by that city at $40,000, as against $60,000 for a steel bridge of like dimensions.

The Fred Crocker estate will erect a fireproof hotel eleven stories high fronting on Van Ness and Sutter streets, San Francisco, to cost $1,500,000 and to be completed in two years. Steel, concrete, brick and stone are the materials to be used.

A RAPID TELEGRAPH SYSTEM.

The French government recently sent an expert to examine the Pollak & Virag system of telegraphy. He reports that from 40,000 to 90,000 words per hour can be sent by using a telephone as a receiver. The transmitter sends positive and negative currents in succession, which act upon a telephonic plate. The vibrations of the plate are intensified as described below, and are registered before the eyes on paper.

All dispatches are first written out in telegraphic characters, resembling the Morse system. Instead of the dots and dashes of the Morse system, however, the ∨ sign is used upright, or inverted, as follows: ∧. These characters are as easily read after a little practice as the dots and dashes. Another point of resemblance to other telegraphic machines is that the machine perforates the strip on which the characters are placed, so that the paper directly over the characters is removed.

The strip, or tape, is carried over a revolving clyinder, on which press two metal brushes, one bearing on the upright ∨, the other on the inverted ∧, so that the brushes and the metallic roller are brought into contact each time that the characters are perforated. The positive current acts on one brush and the negative on the other, and the two currents go forth in the wire of the line.

The following is the mode of telegraphing:

The telegram is placed in the machine, the cylinder turns and the dispatch runs unaided on the line. Upon arrival, the current enters the receiving telephone, the positive attracting the telephone plate on one side and the negative on the other. Under this double influence, the plate oscillates and vibrates, but so slightly that the oscillation cannot be utilized directly, so a small metal stem or wire is attached to the center of the plate, and to this little stem is attached a diminutive mirror lighted by a lamp. This idea is borrowed from submarine telegraphy. The luminous ray is reflected by the mirror, and the smallest deviation of this mirror brings about a great disturbance at the extremity of the ray. It can thus be imagined how the oscillation of the telephonic plate acts upon the mirror, which in its turn determines an appreciable movement at the extremity of the ray of light. This ray is projected on a rolling cylinder carrying sensitive paper, and at each oscillation of the plate the luminous pencil marks on the turning cylinder an upright ∨ or inverted ∧ corresponding to the positive or negative sign transmitted.

it remains only to develop the sensitive paper and to read the signs and words.

The idea consists of reception by telephone and inscription by mirror, as in the Thompson system of submarine telegraphy.

The results obtained by the system, therefore, have been the transmission at a distance of 1,000 kilometers (621 miles) of eighty thousand words in one hour over two bronze wires of great conducting power. Forty thousand words, or sixteen pages of journalistic matter, have been transmitted in twenty-five minutes. This represents more than thirty hours' work of an experienced telegrapher with the Hughes machine now in use, and more than five days and five nights of consecutive labor with the Morse system.

The speed of the Pollak & Virag machine is unprecedented, but it has its disadvantages, in the opinion of the French expert. He enumerates the following points: The telegram must first be changed into characters, after the manner of the Morse system; then the strips must be perforated, as in the Wheatstone system; after reception, the photographed strips must be developed and then translated into ordinary language. It is thought that this complicated manipulation may lead to many errors in transmission, and for present use in France he concludes that the Baudot machine actually employed answers all requirements.

WHAT CONSTITUTES PROPER CLAY FOR PORTLAND CEMENT.

By W. H. Hess.

(A contribution from the laboratory of the Omega Portland Cement Company, Jonesville, Mich.)

There are found in Michigan two types of clay, either one of which may be used in the manufacture of Portland cement. It is convenient to classify these as *Primary* and *Secondary* clays, according to their mode of occurrence. The primary clays are those formed "in situ" by the decomposition of felspar. They are more or less shaly in character and seldom contain more than traces of lime and magnesia. The secondary clays are those which have been removed from their original places of formation by running water and deposited in the low lands when the water ceases to have current enough to hold the particles in suspension. The secondary clays invariably contain lime and magnesia and usually some sulphate of lime. The primary clays are also conveniently divided into two classes—the fusible and nonfusible, or refractory; this property of fusion depending on the relative combined percentages of alumina and iron as compared to the percentage of silica. The following analyses are given as examples:

	Secondary Clay.	Primary Clays. I.	Primary Clays. II.
Silica	39.53	58.24	68.21
Alumina	11.46	20.56	18.64
Iron	4.59	5.68	5.32
Oxide of lime	13.78	0.61	0.22
Oxide of Magnesia	5.19	0.24	0.16
Sulphuric anhydride	1.62	0.01	0.12
Loss on ignition	23.83	15.40	7.33

ECONOMIC CONSIDERATIONS.

Such a secondary clay is not an ideal clay, but it can be used. Its disadvantages are: (1) High content of magnesia and gypsum; (2) the high percentage of lime will make frequent analysis necessary; (3) the temperature of calcination may be variable, and, therefore high; (4) in case transportation from a distance is necessary, 20 per cent of the weight is not clay.

Primary clay, No. 1, is an ideal clay. It will combine with carbonate of lime at a comparatively low temperature: It will, therefore, be economical in the amount of fuel required for the calcination of the cement. It had a disadvantage in rotary practice that underlimed slurry clinkers and the fused mass interferes with the burning. With this clay careful chemical work is necessary, and the temperature of calcination must be carefully controlled. It will give the best cement at the least cost when properly handled.

Primary clay, No. 2, is an economical clay for transporting long distances. It will not be economical in fuel; for the temperature of calcination of the clinker must be high. The clinker will not fuse in the rotaries and gives trouble, even though the content of lime varies. This clay can, therefore, be used without necessitating careful chemical control of the mixture of raw materials, and the calcination need not be so troublesome. As the industry progresses and competition becomes keen, this clay will be replaced by a clay that is higher in per cent of alumina and lower in percentage of silica, such as clay No. 1. A slurry of constant composition will become necessary, and the temperature of burning will be guaged so as to be as low as possible without sacrificing the quality of the cement produced.

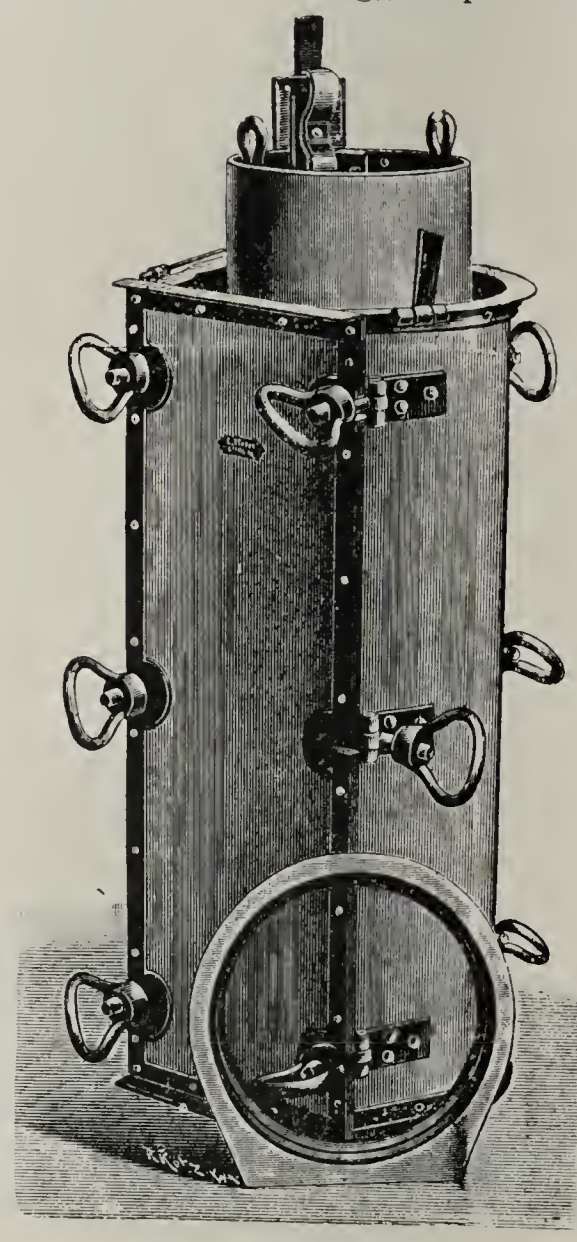
Feb. 5, 1900.

A stock company has been formed to promote a cement plant at Scottsville, Mich.

The Monolith Portland cement company (limited), capital $500,000, propose to erect a plant at Bristol, Mich., and use the water power available by damming the St. Joseph river at that point.

METAL MOLDS FOR CONCRETE SEWER PIPE.

The extensive use of concrete sewers in the cities throughout Germany has incited German manufacturers to construct labor-saving devices for the production of sewer pipe. We illustrate three molds constructed of sheet metal 3 mm. thick, held together over cast-iron shapes, to produce either the round or egg-shaped sewer



Round Concrete Sewer Mold.

pipe. The core of the mold, which is held in position by an upright plate, can be collapsed and withdrawn by removing the plate after the concrete has set. The outer mold can be knocked down by simply unscrewing the hinge-clamps. These molds are manufactured at Guben, Germany, by Ernst Tietze. A mold, complete, for producing 20-in. concrete sewer forms is sold at $36 at the factory, while a 40-in. mold costs $76 complete.

The machinery for the Buckhorn Portland cement company at Rowlesburg, W. Va., on the Baltimore & Ohio railroad is being put in place.

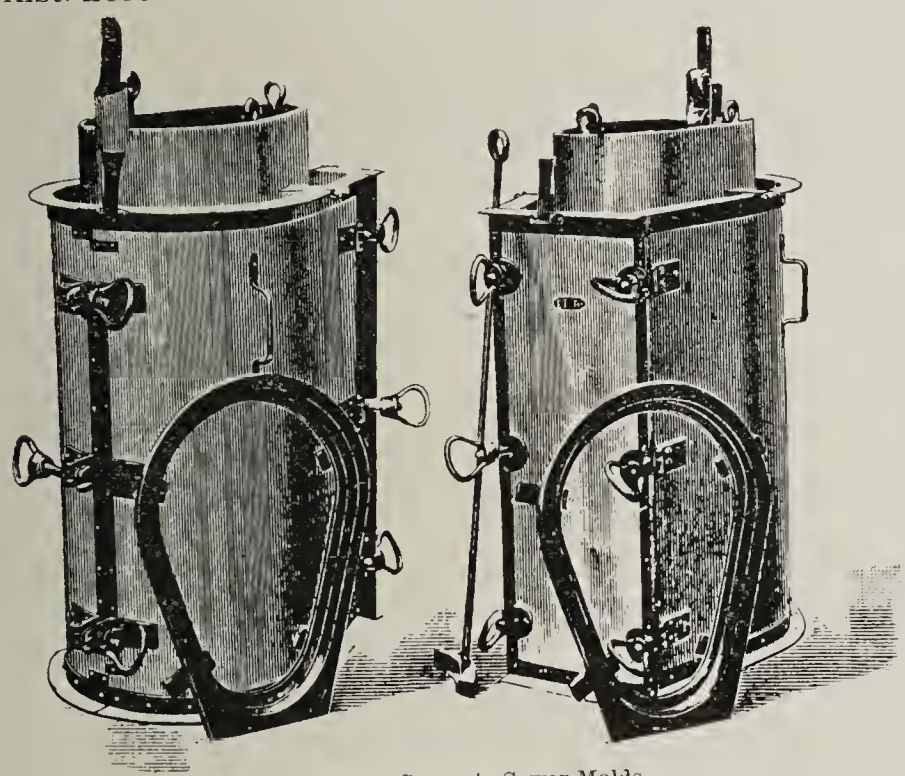
The Pennsylvania railroad will erect a masonry viaduct at the Randolph street crossing after plans by the company's engineer. There will be an 80-foot steel arch entirely covered with concrete. The design will be artistic and substantial. The sidewalks will be of cement.

SIDEWALK CONSTRUCTION IN WASHINGTON, D. C.

The amount of cement sidewalks laid during the fiscal year was 57,538 square yards. The price, 98 cents a square yard, was so favorable for doing this work that many citizens availed themselves of the opportunity to have walks constructed in front of their premises. Most of the brick walks throughout the city are in a lamentably poor condition, and it is doubtful if there are many cities in the country of the size of Washington which are not better provided than the capital city in this respect. The work of replacing these bad walks has progressed as rapidly as possible with the amount of money available for the purpose, and the demand for new walks in the various sections of the city was so great that the office was unable to do as much toward replacing these old walks as it desired, they being replaced, as a rule, only in cases where the work was especially requested by the property owners.

Several instances have occurred during the year where cement walks have failed along the joints, due to expansion. This has occurred only in the longer walks, and means will be taken by inserting expansion joints to avoid this trouble in the future. No instance occurred of walks having been thrown by frost, although during the past winter Washington experienced the coldest weather known in the city since the establishment of the weather bureau, if not the coldest that has ever visited the District of Columbia.

The policy adopted by the office requiring permits for sidewalks to be laid by parties other than the district has given most excellent results. Formerly, private parties were permitted to lay walks in the street whenever they so desired. This resulted in many walks not being laid at proper grade, and where the walk was of brick it was frequently laid unevenly and of material of inferior quality; if of cement the work would be so poorly done that the walk would begin to break up or become uneven within a year or two and frequently within less time. The policy was therefore adopted of requiring a permit for every such construction by private parties. If the walk was to be of cement the permit required that it should be laid in accordance with district specifications for this class of construction, and the party desiring the work done was required to deposit an amount sufficient to pay the cost of a district inspector upon the work at the rate of $4 per day. These requirements are not believed to work a hardship to the property owners, in view of the very low contract price at which the district can lay the walks—one-half of which is paid by the district—so that the only way the property owner can save money by laying the walks himself is by putting down an inferior grade, which is the very thing the office is trying to avoid. Owing to the manner in which the work is now managed by the office the only cases in which the property owner desires to do the work himself is where some emergency arises and he does not feel willing to wait until his turn arrives for the district to build his walk for him.—Report of the Engineering Department, District of Columbia.



Egg-Shape Concrete Sewer Molds.

A large deposit of high grade asphalt located near Tampico, Mexico, is to be worked by a strictly Mexican company. All foreign capital or citizens will be barred from the enterprise

D. J. Hale is preparing a paper on cement materials.

A cement plant is projected at Rossville, Md., on a 40-acre tract at that point.

Four concrete store buildings will be erected at Molena, Ga.; by Col. G. D. Dominick and J. A. Galand.

Bay City, Mich., has a Portland cement plant in view; 1,200 acres of marl land are held under option by the projectors.

William H. Keeler will erect a 12-story fireproof hotel on the corner of Maiden Lane and James street, Albany, N. Y., to cost $250,000.

A Portland cement plant is under consideration at St. Louis, Mich. Cleveland (Ohio) parties are investigating the value of the marl deposits in that vicinity.

McDevitt & Ramsey have the contract for reconstructing the interior of the building on Fourth and Chestnut streets, Philadelphia, and will use concrete in the floors.

Dr. Alfred C. Lane and a corps of assistants of the Michigan geological department are making a thorough examination of the Southern Peninsula for marl clay and coal deposits.

J. L. Bernard of the Atlas Portland cement company has gone to Cuba in the interest of his company. The sales of the Atlas cement has increased 100 per cent since the improvements at Havana have commenced under the United States authorities.

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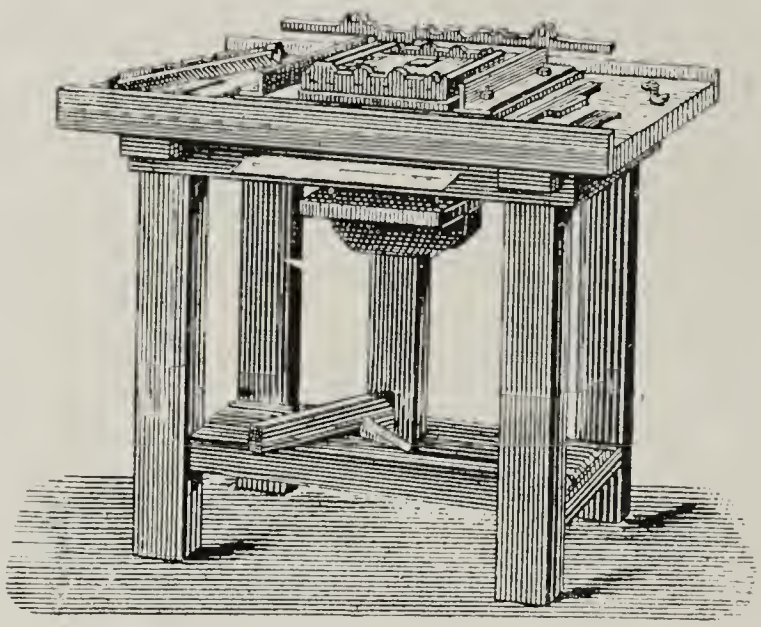
GERMAN MOLDING TABLE.

Below we illustrate a German press and molding table, used for producing artificial stone blocks, floor tiling and raised work. The table is fitted with a plunger operated by a lever worked by foot power, to compress the concrete in the mold-box from beneath. The top of the plunger joins the bottom of the mold-box. A smoothing and grooving implement, working in grooves on either side of the mold-box, is operated by hand across the face of the concrete to produce a grooved or smooth pattern, as desired, the work produced being governed by the design on the striking implement. This outfit is sold in Germany at $25 and consists of the table and plunger, 2 striking or smoothing implements, 1 wooden hammer, 1 sieve, 1 metal shovel and a hand brush.



The cement-dealers of the Trans-Mississippi territory met at Kansas City, Mo., to raise prices. The delegates assembled under a call signed by J. C. Beach of Wymore, Neb.

The Great Northern railway company is piercing the Cascade range between Wellington and Cascade by a tunnel 13,253 feet long, 24 feet high and 20 feet wide to be lined throughout with concrete. One hundred and fifty men are now employed on the concrete work. The work is to be completed during the present year. Four thousand seven hundred feet were completed on the western end from Wellington and 4,300 feet from Cascade, the eastern end, leaving 5,253 feet unfinished. The concrete work follows close after the excavation. Electrical traction will be used through the tunnel.

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A brewery floor at Mankato, Minn., laid with Mankato cement, expanded four inches between the walls, caused them to bulge and distort the building lines, thirty days after the floors had been put in, due possibly to the absorption of carbonic acid gas by the free lime and magnesia present in the cement.

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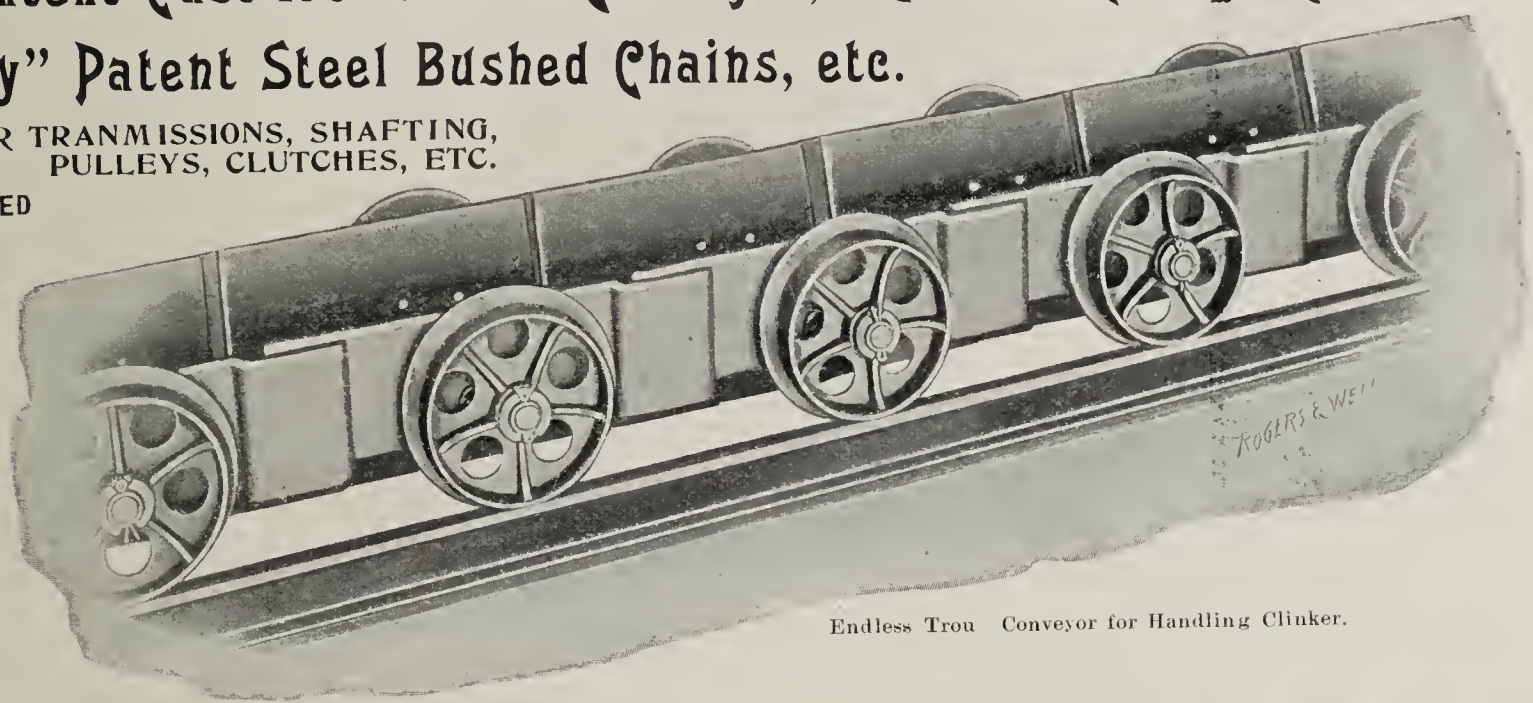

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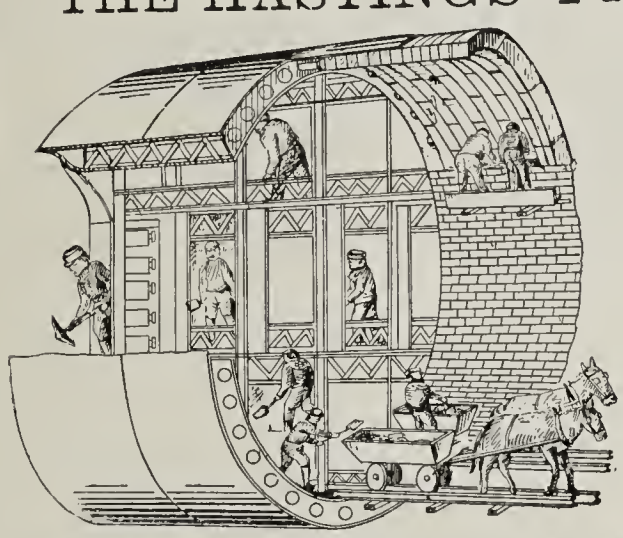

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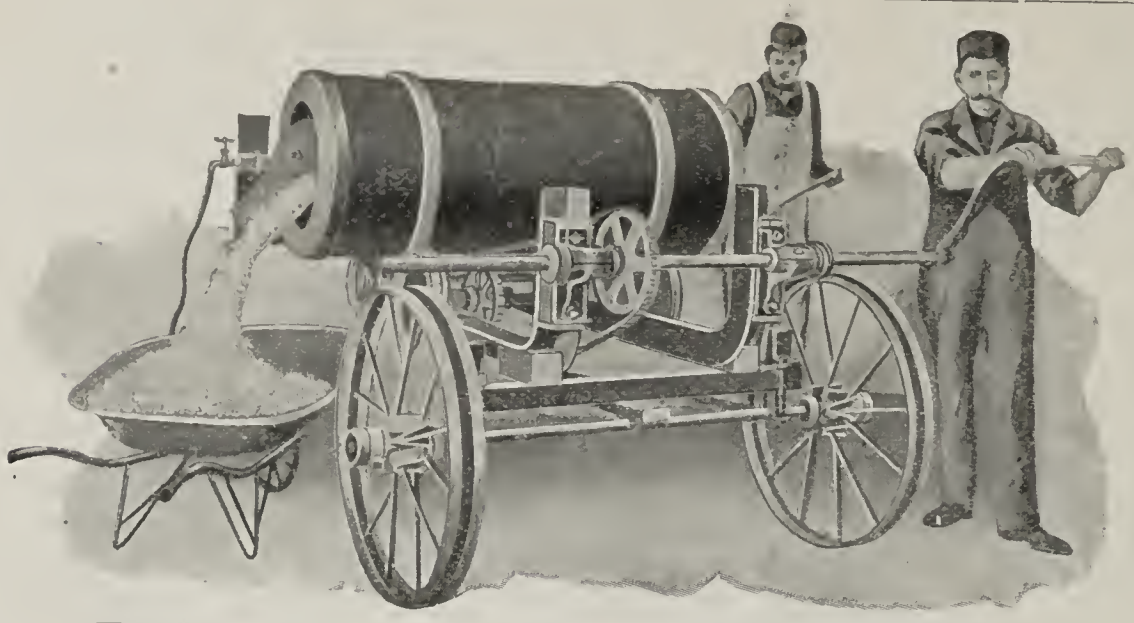

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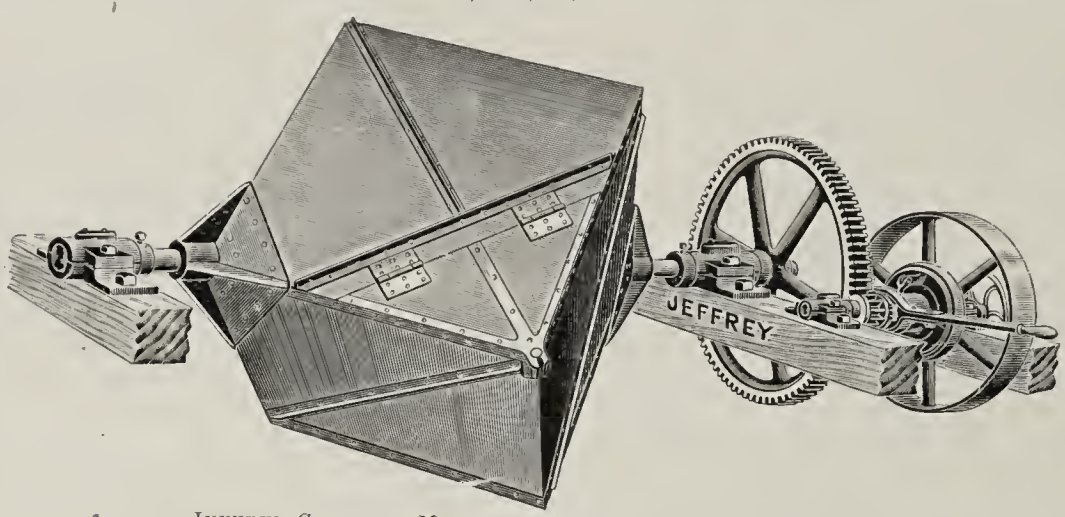

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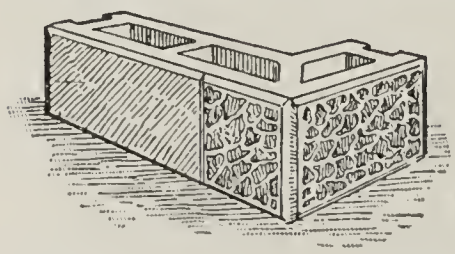

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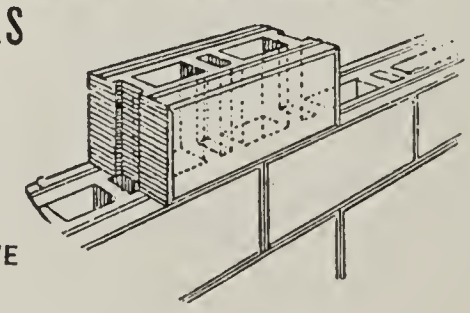

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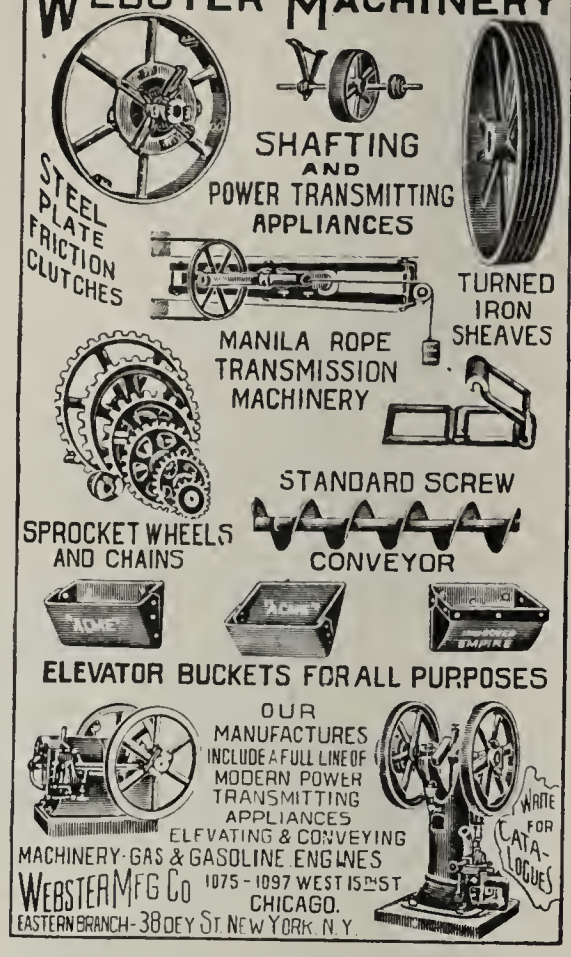

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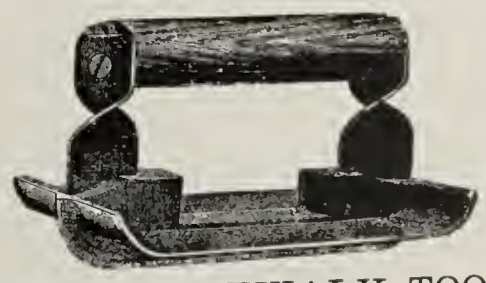

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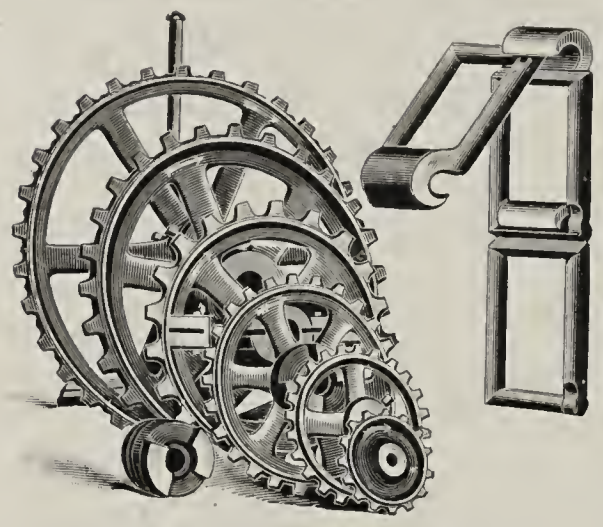

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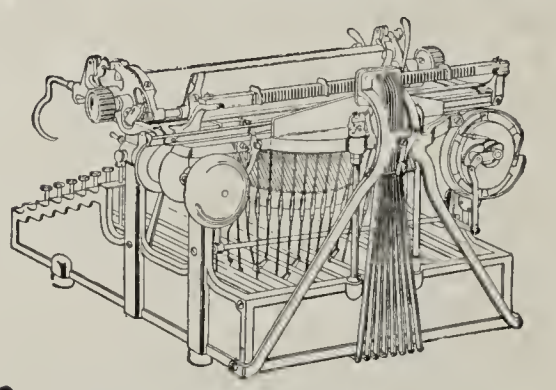

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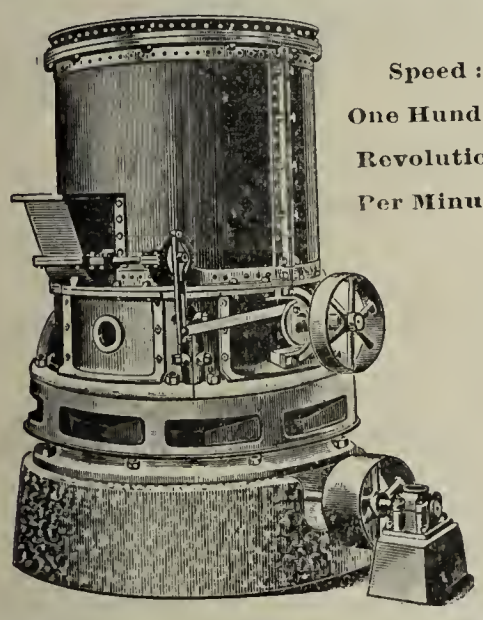

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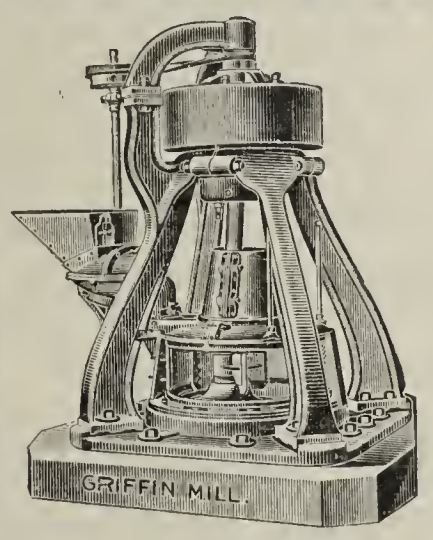

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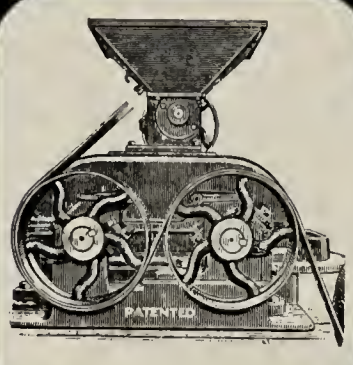

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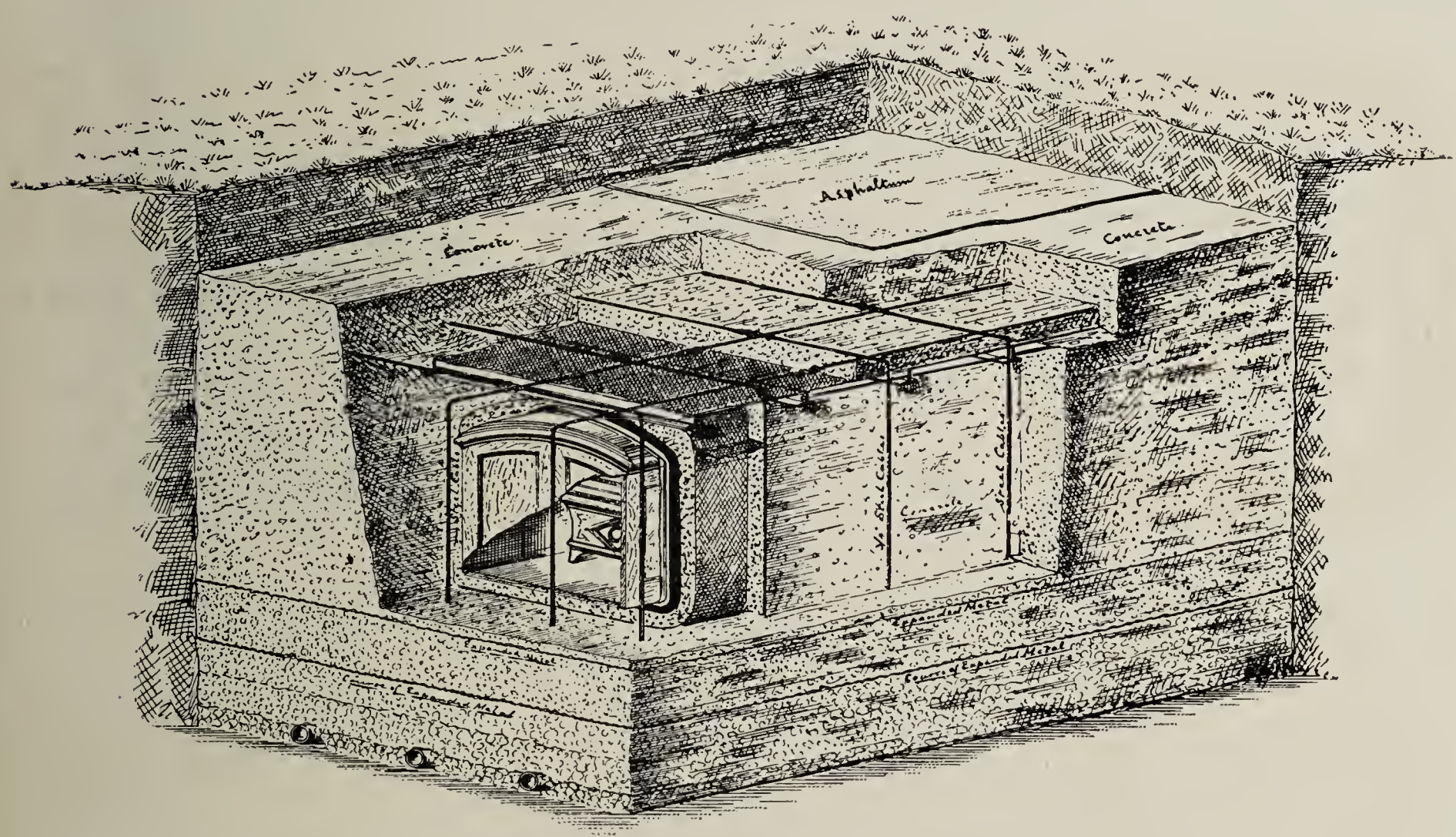

CONSTRUCTION OF A SEPULCHRE FOR A CHICAGO MILLIONAIRE.

Built of concrete, expanded metal T-beams and steel cables, 14 ft. long 8 ft. 6 ins. deep, 8 ft. wide. The excavation was made 10 ft. deep. Running water was encountered, covering the bottom one foot, compelling the constant use of a steam pump. Clay drain tile were laid and covered with dry crushed stone and Portland cement, 12 ins. deep, a layer of expanded metal was next spread over the area and additional layers of concrete deposited, followed by another layer of expanded metal lath; six steel cables were next laid on the concrete and brought up through two layers of concrete and expanded metal. The burial chamber is lined with 2 ins. of asphalt and surrounded by a 6-in. layer of concrete covered with expanded metal. After the concrete reached the full height of the coffin space the cables were bent back and the sides of the excavation covered with canvas, sloping down from the sides, leaving only the coffin space exposed, with the outer casket in place. The pump was stopped only during the interment of the remains. Layers of asphalt paper were spread over the outer casket and the asphalt completed. T-beams were laid across the opening, as shown, and covered with expanded metal. A layer of concrete was deposited thereon; the steel cables were picked up and spliced at the ends and covered with a layer of concrete. The entire mass of concrete was finished with a covering of rolled asphalt, as shown in our illustration. The sepulchre contains the remains of one of the best known millionaires in this country.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and u blisher.

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

The next annual meeting of the International Mining Congress will be held at Milwaukee, Wis., June 19 to 23 inclusive. For information address T. J. Sullivan, secretary, 40 Sentinel Bldg., Milwaukee, Wis.

THE BUILDING TRADES STRIKE.

Chicago is the dumping ground for the dregs and refuse of the earth and is, therefore, a specially inviting field for the walking delegate to exercise his calling in the breeding of strikes and fermenting boycots against every species of honest enterprise employing labor. Chicago is now face to face with a semi-annual strike covering the building trade industry, resulting in withdrawing millions of dollars of projected work from architects' boards. The sweeping demand of the trade unions has made capital timid and it hesitates to embark on well matured plans of improvement.

The walking delegate's formulated demands cover the right to dictate who the master builder shall employ in every instance, reserving to himself the right to use brute force to prevent others from working who do not belong to the union. Whenever an individual sets himself up as stronger and higher than the law he becomes a dangerous factor in society and should be suppressed by the strongest precept of positive law. To regulate the matter every walking delegate should be compelled to take out a public license and sworn to observe the law.

Chicago is, at present, the chosen ground upon which the first battle is to be fought between union labor and the Master Builders, sustained by all the affiliated unions throughout the country. A victory here will simply transfer the contest to other regions. Certain finished building materials, worked by union labor outside of Chicago, cannot be used in Chicago under the rules of the local unions. Stone cut outside of Chicago by union labor in good standing is placed under the ban by the Chicago stonecutters' union, and yet these outside unions are called upon to contribute funds to support the present strike, while their labor is banned and barred in Chicago.

The Master Builders now have few rights labor unions are bound to respect. Large industrial enterprises are beginning to avoid Chicago owing to the unsettled state of the labor market. African savages have a saying that apes are human beings who will not talk in order that they may not be compelled to work. Why should the walking delegate not be tried by the same standard and be made to perform honest labor, since his life and energy is dedicated to chaos and talk; he sows discord and dissension; he should receive judicial notice to quit hampering honest enterprise. There is a pressing call that he should vanish in the interest of mankind.

REMODELING UNSIGHTLY BRICK BUILDINGS.

The old Leroy Payne stable building on Michigan Ave., Chicago, occupies a leasehold valued at nearly a half million dollars, and has long been a discredit to the neighborhood. Our illustrations on two other pages shows the old building, and as it is remodeled after plans by Shepley, Rutan & Coolidge, architects of Boston and Chicago.

A new and pleasing facade has been produced by the aid of expanded metal and Portland cement concrete at a very moderate cost. Wooden furring strips were nailed to the old brick walls and on these expanded metal laths were nailed, covering the entire front of the building, except openings. Portland cement mortar was laid on and troweled smooth, galvanized sheet metal being used for cornice and window caps. The Northwestern Expanded Metal Co. of Chicago did the expanded metal work. The contrast between the old building and the new front demonstrates the practical value of concrete and expanded metal in rehabilitating unsightly buildings. Several other Chicago down-town business blocks have been given this class of finish with uniformly satisfactory results. Architects and builders are beginning to see the utility and beauty of expanded metal and concrete finish where economy and durability and rapid work are desirable.

The Osborne Co., Osborne Bldg., Cleveland, Ohio, has been retained to prepare plans and specifications for a new cement plant for the Austin Portland Cement Co., to be located at Austin, Texas. Equipment contracts will be awarded as soon as specifications can be prepared.

Nature gave men business capacity, advertising sets it to work.

Send in your subscription for the CEMENT AND ENGINEERING NEWS.

IMPORTS OF CEMENT INTO THE UNITED STATES.

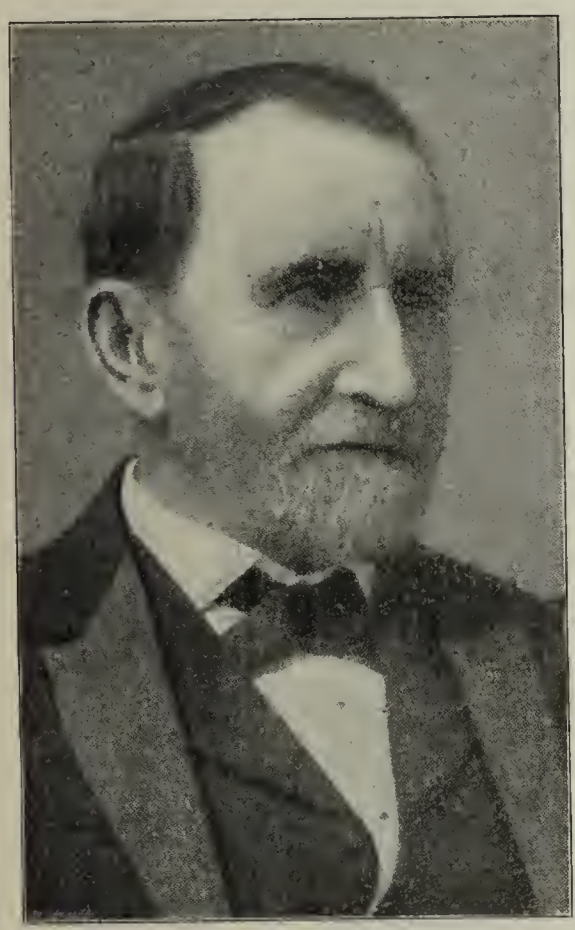
WHERE FROM.	JANUARY. 1899. QUANTITY IN LBS.	JANUARY. 1899. VALUE IN DOLLARS.	JANUARY. 1900. QUANTITY IN LBS.	JANUARY. 1900. VALUE IN DOLLARS.	SEVEN MONTHS ENDING JANUARY. 1899. QUANTITY IN LBS.	SEVEN MONTHS ENDING JANUARY. 1899. VALUE IN DOLLARS.	SEVEN MONTHS ENDING JANUARY. 1900 QUANTITY IN LBS.	SEVEN MONTHS ENDING JANUARY. 1900 VALUE IN DOLLARS.
United Kingdom....	8,373,834	33,212	9,034,600	35,987	77 753,179	281,625	56,674,867	225,761
Belgium..	21,711 504	66,461	30,237,938	92,546	173,642,705	531,667	172,633,609	515,932
France.....	.....	.....	297,600	1,199	4,823,600	14,431	3,725,745	13,722
Germany.....	14,478,749	67,184	23,549,499	85,935	255,708,664	889,401	299,647,331	1,066,616
All Other Europe ...	6,416,688	5,027	1,585,920	6,087	15,512,852	32,756	16,898,318	54,881
British North Am...	.....	.....	38,850	181	1,043,120	4,729	897,790	5,011
Other Countries.....	2,000	9	1,401,760	6,848	2,000	9	2,357,260	11,535
TOTAL	50,982,555	171,893	66,446,167	228,783	528,486,120	1,754,618	552,834,920	1,892,458
Domestic Exports of Cements, bbls.	2,521	5,044	5,718	11,565	19,960	42,217	40,125	83,450

There were 3,025,699 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on January 30, 1899, valued at $8,940, against 5,586,054 lbs., valued at $18,928 in January, 1900.

Imports of asphaltum or bitumen for January, 1899, were 2,011 tons valued at $6,184; January, 1900—2,096 tons valued at $8,117. For seven months ending January, 1899, 36,595 tons valued at $110,492; for seven months ending January, 1900—63,252 tons valued at $197,094.

AN INDUSTRIAL CAPTAIN OF THE NINETEENTH CENTURY.

Mr. I. C. Johnson, one of the original Portland cement manufacturers, was born January 28, 1811, at Vauxhall, London, Eng., of humble parents. He entered the employ of Messrs. Francis & White, manufacturers of hydraulic cement, when a mere lad and worked in every department of the plant. Desiring to learn a trade he became apprentice to a joiner for four years, paying £20 premium, and received 8s. per week the first year, 12s. the second and 16s.



ISAAC CHARLES JOHNSON, J. P.

the third, and 18s. per week the last year. He mastered architectural drawing after working hours, became a draughtsman, studied mechanics and the natural sciences and became proficient in chemistry. Mr. Johnson next entered the employ of Mr. J. B. White, formerly of Francis & White, taking charge of the cement plant at Swanscome where he introduced the manufacture of Portland cement under his own formulas. After 14 years' service he embarked in the manufacture of Portland cement on his own account at Findsbury, Rochester, being the first cement plant on the Medway, and subsequently erected another plant at Cliff-at-Hoo, selling the output to Messrs. J. B. White & Sons, his last employers, who shipped the cement to France. Mr. Johnson now began the study of the French language in order to be prepared to deal with the French in their own language, which he soon mastered. Visiting France he secured large government contracts. The business greatly increasing, he formed a private company under the name of I. C. Johnson & Co., taking in outside capital, and erected a new plant at Newcastle to supply the German trade, these works extending more than a quarter of a mile along the banks of the Tyne at Gateshead. The growing business called for still another plant which was erected at Greenhithe, on the Thames, where a patent process, invented by Mr. Johnson, was introduced in the manufacture of Portland cement and adopted by many of the Portland cement manufacturers on the Tyne, Thames, Wear and Medway, paying for the use of same. A soon as the German export business began to assume proportions Mr. Johnson took up the study of the German language and persisted until he was able to write the language fluently in his daily correspondence. Mr. Johnson is still at the head of a very extensive business and rode the bicycle in his 88th year for physical exercise. He is mayor of the borough of Gateshead and has been made county magistrate. Mr. Johnson is strictly temperate and now and then addresses his employes on the subject. Mr. Johnson's life personifies what can be accomplished by persistent efforts properly directed.

CAUSES OF INFERIOR PORTLAND CEMENT.

By Edward Duryee.

Coarse grinding of the cement—When used in mortar with good sand it appears to be pretty well established that the value of standard commercial Portland cement is increased 25 per cent by grinding to a fineness of 1 per cent residue on a 100 mesh screen, and 50 per cent by grinding to a fineness of 3 per cent residue on a 200 mesh screen.

As an inducement to manufacturers to produce a finer ground cement it is suggested that government specifications give a preference to the finer ground cements and offer a premium of 10 per cent of the purchasing price of the cement for a fineness of 1 per cent residue on a 100 mesh, and 20 per cent for a fineness of 3 per cent residue on a 200 mesh screen, provided the cements show satisfactory increase in strength with sand and stand the other tests very satisfactorily.

Coarse grinding of the raw material—Where the carbonate of lime is of a crystalline character it is necessary to grind the raw mix very much finer than is the case with marls or chalks to prevent the lime remaining uncombined in the cement.

Over-claying or under-claying—In either case the cement is sure to crack or crumble. If it is over-clayed the mortar is apt to crack in a short time; if under-clayed, it may not crack for several months. It is possible that a few good tensile tests may be obtained with it in either case for medium length periods.

In some deposits of raw materials the proportion of magnesia is too high to permit the manufacture of a reliable cement. In others there is such a high percentage of quartz sand that the cement is inferior in tensile strength. In some cases the deposits are so irregular in composition that it is practically impossible to secure a uniform product.

Imperfect burning—Under-burnt cement will contain a large proportion of free lime and the mortar will swell and crack. Over-burnt cement will be of inferior tensile strength and of poor setting quality.

Lack of uniformity in the raw mix—If the stone and clay are not mixed uniformly the cement will vary in composition and quality.

Allowing quantities of under-burnt clinker to be ground with the good clinker.—This practice introduces free lime into the cement and injures its color.

Neglect to thoroughly mix large quantities of cement.—Thousands of barrels of cement should be thoroughly mixed in order to secure uniformity in color, setting time and quality.

Cement is sometimes stored in damp locations, or when the weather is damp it is exposed in bulk or in packages not moisture proof. Two days under such conditions will sometimes cause a deterioration of 50 per cent in the tensile strength.

Failure to properly cure the freshly ground cement—When necessary the cement should be spread in dry bins to the depth of ten inches, shoveled over occasionally, and kept until it is cured.

Failure to properly sample and test all cement before it is shipped—No cement should be allowed to leave the works until satisfactory laboratory tests are reported by the chemist.

Uniformity in the raw mix is promoted by maintaining a uniform temperature in the laboratory. As some quick method of determining the lime is necessary we calculate the percentage from the volume of carbon dioxide gas that is driven off by acid, and these volumes should be measured at temperatures as nearly uniform as possible, in order to secure reliable results.

In damp weather, or when cement is to be left some time after shipment the packages used for shipping should be moisture proof, otherwise it will deteriorate by absorbing moisture from the atmosphere.

Colton, Cal.

THE OLD LEROY PAYNE STABLE BUILDINGS, MICHIGAN AVE., CHICAGO.
(BEFORE REMODELING.)

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As Remodeled with Concrete and Expanded Metal Lath. Now occupied by an Electric Vehicle Company.

NORTHWESTERN EXPANDED METAL CO.,
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THE MANUFACTURE OF PORTLAND CEMENT FROM ALKALI WASTE AFTER TREATMENT BY THE CHANCE SULPHUR RECOVERY PROCESS.

By Charles Spackman, F. C. S.

(From the *Journal of the Society of Chemical Industry.*)

The accumulations of waste from the manufacture of soda by the Leblanc process have long been a source of unceasing trouble and expense to the manufacturers, and the proposal to make use of this waste as the lime constituent of Portland cement is not new. In a book on Portland cement, by H. Reid, published in 1877, reference is made to experiments carried out at St. Helens some years previously with a view to its utilization for this purpose, which were not successful, as the sulphate of lime interfered with the production of a perfectly hydraulic cement.

A paper describing his process for the manufacture of cement from alkali waste was read before the Liverpool section of this society by J. S. Rigby, in which the author states that his attempts to produce cement with the unpurified waste were unsuccessful.

"It produced a cement of a very uncertain quality. When made into briquettes and placed in water they frequently crumbled away, or if they held together at all a very slight strain caused them to break. The cement had also an upleasant, slippery feel with it when taken from the water; it also evolved sulphuretted hydrogen when treated with an acid."

Cement of good quality was, however, obtained by purifying the waste. This was said to be accomplished by passing carbon dioxide, obtained from the calcination of a previous kiln of cement, through the semi-liquid waste, either before or after it had been mixed with the required quantity of clay. A second paper, by the same author, considers the action of calcium sulphate on cement, and describes a continuous process of calcination.

In Mr. Chance's paper, describing his sulphur recovery process, three analyses of the waste after treatment by this process are given and reference is made to the possibility of utilizing it for the manufacture of cement. In this paper I propose to briefly consider this subject and to give the result of an actual experiment.

The analysis of the waste, with which my experiments were made, was as follows:

Coke	2.492
Sand	1.094
Silica	1.156
Alumina	0.926
Ferrous sulphate	1.488
Ferrous sulphide	0.421
Calcium carbonate	68.861
Calcium sulphate	4.735
Magnesium carbonate	2.428
Soda	0.962
Water	15.714
	100.277

Sulphur compounds exist here in much larger quantity than in the samples of which analyses are given by Mr. Chance. The presence of sulphur to any great extent in the raw materials is liable to seriously interfere with the production of Portland cement of even moderate quality, and as the material in question will always certainly contain a small quantity, and may contain a considerable one, we must, as a part of our subject, consider what its effects are, and to what extent its presence is detrimental.

The action of sulphates on lime was first investigated by the late General Scott, R.E., F.R.S., now more than 35 years ago. Experimenting with the Plymouth hydraulic limestones and burning a piece of the stone in a dull fire, he found, on grinding to a fine powder and mixing with water, that instead of slaking and heating as previous samples had done it set and hardened in exactly the same manner as a cement. He consulted Dr. Faraday respecting this, and they came to the conclusion that the change was due to the formation of some form of sub-carbonate of lime. It was, however, subsequently ascertained that it was caused by the presence of a small quantity of calcium sulphate formed by the action of the iron pyrites of the coal. This led to the invention of Scott's cement, which was made as follows: Grey chalk lime, such as that of Burham on the Medway, containing from 10 to 15 per cent of clay, was reheated to redness in shallow kilns with perforated hearths. When the lime was sufficiently hot, pots of sulphur were placed beneath the hearths, the sulphur being immediately ignited by the heat of the kilns. The sulphur dioxide evolved combined with the lime to form calcium sulphite which afterwards passed to sulphate. When finely ground the cement was ready for use.

This system of manufacture was, about 1871, abandoned for a much simpler one, the lime being finely ground with a certain proportion of gypsum. When so treated it is known as selenitic lime, and it is now manufactured in large quantities from the hydraulic limestones. Mortar made with selenitic lime hardens rapidly and possesses a much greater strength with a larger proportion of sand than if made in the ordinary manner with the same lime not made selenitic.

General Scott also found that by the addition, while grinding, of a quantity not exceeding 2 per cent of gypsum to hot over-limed Portland cement, with a tendency to expand and blow, it could be rendered fit for immediate use without undergoing the usual process of air slaking, and that sound, but quick-setting cement could be rendered slow-setting by the same treatment. This fact is now so well recognized that the German standard rules, which most stringently regulate the addition of any foreign substance to Portland cement by the manufacturer, allow gypsum to be added in quantity not exceeding 2 per cent to confer slow-setting properties. Its effects are well illustrated by the results given in the following table by Messrs. Dyckerhoff, taken from the Minutes of Proceedings Inst. C.E., Vol. LXII, p. 92, which shows the gradual increase in the time of setting of a sample of quick-setting cement by the addition of ½, 1, and 2 per cent of gypsum, and the corresponding increase of strength, both neat and with three parts of standard sand at from one to fifty-two weeks:

Table by Messrs. Dyckerhoff.
Showing the increase in strength which results from an increase in the time occupied in setting.
Kilogrammes per sq. centimetre.

No.	One Sort of Cement.	Time of Setting Neat.	Neat Cement. 275 Grms. of Water to 1,000 Grms. of Cement.						One of Cement to Three of Sand. Standard Test.				
			One Week.	Four Weeks.	Twelve Weeks.	Twenty-five Weeks.	Fifty-two Weeks.	One Week.	Four Weeks.	Twelve Weeks.	Twenty-six Weeks.	Fifty-two Weeks.
1	.....	Minutes. 20	22·7	28·5	36·4	43·7	49·3	8·1	11·8	16·7	21·2	25·3
2	The same cement with ½ per cent. of gypsum	210	22·2	32·1	40·3	43·9	45·8	10·0	14·9	23·8	24·8	27·4
3	The same cement with 1 per cent. of gypsum	600	26·4	35·7	39·9	49·0	54·9	11·2	16·7	21·9	25·9	27·0
4	The same cement with 2 per cent. of gypsum	840	29·9	38·2	48·4	50·5	56·7	12·7	18·5	21·4	26 3	28·8

We must now consider the calcium sulphate occurring as one of the constituents of Portland cement, instead

of being added after burning. The materials in general use for the manufacture, as a rule, contain sulphur compounds in such small quantity that practically their presence may be disregarded. At the same time calcium sulphate occurs in more or less quantity in all Portland cement, its presence being due to the coke used as fuel. The sulphur dioxide evolved during its combustion, in passing upwards through the layers of unburned material in the kiln, to some extent, attacks the calcium carbonate forming, ultimately, calcium sulphate, as in the manufacture of Scott's cement, except that in the latter case entire absorption of the sulphur dioxide was secured by heating the lime to redness. The formation of calcium sulphate is less in open than in closed kilns, and less in some forms of closed kilns than in others. The quantity, however, due to this cause is too small to, of itself, at all influence the character of the cement, but many French engineers attach great importance to the freedom of Porland cement from sulphuric acid—it is difficult to understand why—and specify a maximum percentage. The cement specification for the Boulogne harbor works contains a clause providing that sulphate of lime shall not exceed 1 per cent, a condition that few, if any, English cements, which are generally burned with gas-coke, could comply with.

If the raw materials, as in the case of the desulphurized alkali waste, contain sulphur in any form—for even under the most careful treatment we know that it must do so, as any ferrous sulphide present cannot be decomposed, and, as we shall presently see, the quantity of calcium sulphate that may be present in the cement is a limited one, the quantity of this due to the ash and iron pyrites of the coke becomes an important consideration, and it is necessary to know what the amount really is. In the following table I have arranged the results of some experiments which show this:

TABLE A.

	Unburned Material.		Cement.
	$CaSO_4$ Per Cent.	FeS_2 Per Cent.	$CaSO_4$ Per Cent.
1.			1·469
2.			1·562
3.	0·234		1·504
4.			1·579
5.			1·694
6.			1·361
7.	0·004		1·990

The mixture as dried ready for the kiln in Nos. 1 to 6 contains only 0.234 per cent of $CaSO_4$, which would give about 0.32 per cent in the cement. FeS_2, a common constituent of many clays, was entirely absent. The kilns were open ones of about 20 tons of cement capacity. About one-half the coke was gas-coke; the remainder was made in ovens underneath the drying flats. The cement from each of six kilns was ground separately and carefully sampled, the $CaSO_4$ being determined in each with the results given in the table. The average of these is 1.528, and if we deduct 0.32 per cent, the approximate quantity due to that originally present in the raw materials, we have 1.2 per cent derived from the coke. Practically, the cement differed in no way from specially prepared samples in which the $CaSO_4$ fell considerably below 1 per cent.

In No. 7, the $CaSO_4$ in the material before burning exists as a mere trace, FeS_2 being absent. The cement was burned in closed kilns, with the result that we get 1.99 per cent of $CaSO_4$ derived entirely from the coke.

[TO BE CONTINUED.]

A SOURCE OF ERROR IN THE ESTIMATION OF SULPHITE OF LIME IN MARLS AND CLAYS.

(A contribution from the laboratory of the Omega Portland Cement Co., Jonesville, Mich.)

By W. H. HESS.

It is quite customary among chemists to use a small portion of nitric acid along with dilute hydrochloric acid in effecting the solution of marl preparatory to analysis. The nitric acid so used oxidizes the iron present in the sample and, as this step is necessary before the final precipitation of iron with ammonia, it is quite convenient to add a small amount of nitric acid along with hydrochloric in dissolving the sample. Moreover, a clearer solution is obtained by the use of some nitric along with the hydrochloric, owing to oxidation of some organic matter.

It was observed in the analysis of marls that the percentages of sulphuric anhydride (SO) were very much larger when nitric acid was used along with hydrochloric acid (1 to 1) than where hydrochloric acid alone was used in dissolving a sample for the estimation of the sulphite of lime the following table will illustrate.

SAMPLE OF MARL FROM	PERCENTAGES OF SULPHURIC ANHYDRIDE FOUND. Hydrochloric only used.	Nitric acid used with hydrochloric.
Jackson Co., Mich.....	0.25%	1.08%
Hillsdale Co., Mich.....	0.10%	1.16%
Clare Co., Mich.....	0.14%	1.42%
Oakland Co., Mich.....	0.16%	1.40%

The question arises, whence comes this extra supply of sulphur? An investigation shows that the sulphur in marl which does not exist as sulphates is not in the form of sulphides, as is the sulphide of lime (CaS) since no hydrogen sulphide is driven off by the addition of a mineral acid. This sulphur must exist, therefore, in the organic matter chemically combined in organic combination similar to the sulphonates or other compounds of sulphur which are not decomposed by mineral acids. The organic matter is burned by the action of the chlorine and oxides of nitrogen set free from hot nitric and hydrochloric acid by mutual decomposition, and the sulphur contained in the organic matter so burned is oxidized to sulphuric acid. The sulphuric acid so formed by oxidation of organic sulphur is then precipitated and weighed as barum sulphate. The percentage of sulphuric anhydride so found is computed into sulphate of lime and thus the percentage of this ingredient is greatly increased. It is, therefore, necessary that all oxidizing agents be avoided in preparing samples of marl, or clay from low lands, for the determination of sulphate of lime.

Analyses of marls have come to the writer's notice in which percentages of sulphuric anhydride were very high, and analysts had condemned deposits on account of high content of sulphate of lime. It is very probable that a portion of the sulphate so far reported had its source in the organic sulphur of the marl. The writer made this mistake before the subject was investigated, and it is the purpose of this communication to warn chemists against such an error.

Incorporated: Carolina Portland Cement Co. Capital $10,000.

The Alsen Portland Cement Co. will erect a plant on the Hudson river.

The Cumberland Valley Cement Co. will rebuild their plant at Cedar Cliff, Mineral county, W. Va.

The Bronson Portland Cement Co. are uncovering a new marl bed of first-class quality and will increase its output from eight hundred (800) to one thousand (1,000) bbls. The plant has been entirely remodeled and now gives absolute control of uniformity of composition and quality of product. Tube mills have been introduced in the wet end for grinding slurry and two batteries of five (5) Griffin mills each for grinding clinker. The coal grinders furnish fuel to replace the oil formerly used. These additions have necessitated an increase of power, which is furnished by Sterling boilers and Corliss engines. A warehouse of eighty thousand (80,000) bbl. capacity has just been completed.

TESTS OF THE CONSTANCY OF VOLUME OF PORTLAND CEMENT.—II.

(From *The Engineering Record.*)

CONTINUED FROM FEBRUARY.

The results of tests for time of setting, fineness, extension and strength may be easily stated in a tabular manner, and those figures which seem to indicate outside influences may be enclosed in parenthesis. It is an entirely different matter, however, to represent the results of tests for soundness, and Mr. Gary therefore adopted a series of signs for designating the different checks, cracks, warping and other physical aspects of the pats and balls. Any reproduction of the voluminous tables accompanying his report is out of the question in these pages, and only his general comments can be reproduced. It might be stated in passing that the tables occupy about 23 large octavo pages.

Setting.—The time and manner of setting of each cement shows a marked variation at the different testing laboratories. This may result from a number of causes: 1. From the difference between the time of preparing and delivering the cement and the time the tests were made. 2. From the different temperature and moisture relations at the time the tests were made. 3. From variations in the amount of water added to the cement at the different places. 4. From the time for mixing the cement mortar or the amount of work in preparing it, which is of influence because the same cement with strong mixing and little water can be brought to the same degree of consistency attained with weaker working and more water. 5. From the different opinions concerning the point of time at which the pressure of the finger nail on the cement pat is considered to leave no impression. In view of all these causes, each of which can influence the time of setting, the occasionally wide deviations are self-explanatory. In order to secure comparable results as to the time of setting at the different laboratories it is necessary to carry out the tests at the same temperature of the air, water and cement, with equal moisture in the air and particularly with the same addition of water to the cement and the same strength and period of mixing the cement mortar.

If all the experiments with the needle are considered of equal weight and the average of the three sets taken, the cements A, B, H and L must be considered quick-setting, and the cements C, G, F, D, J and U as slow-setting. According to the results obtained at the Royal Testing Laboratory, cements A, B, D, H and L are quick-setting. During the course of the setting a rise in temperature appeared as soon as the pats were made, or within a short time; it corresponded in amount to the more or less rapid course of the setting process. The different results obtained at the different places are apparently mainly due to the difference in the amount of water used. In reading the rise in temperature, attention must be paid to any change in the temperature of the surrounding air.

CHEMICAL AND PHYSICAL PROPERTIES OF THE TEN PORTLAND CEMENTS.

Brands.—See Page 58.

	A	B	C	D	F	G	H	J	L	U
Chemical Analyses.					Per Cent.					
Residue insoluble in HCl	0.75	1.06	0.36	1.12	1.58	0.67	0.41	0.71	0.91	0.49
Silica	21.27	21.10	19.47	19.49	21.31	21.25	22.54	20.96	20.34	20.63
Iron oxide	3.28	2.69	4.12	3.20	3.22	2.80	2.80	2.73	2.82	3.01
Alumina	6.34	7.93	8.41	8.86	7.64	7.44	6.25	7.45	7.94	6.52
Lime	63.62	58.67	61.23	59.49	56.92	62.03	60.08	61.12	59.88	61.88
Magnesia	0.91	1.98	1.70	1.37	2.27	1.08	1.55	1.86	1.06	0.72
Sulphuric acid	0.91	1.62	1.73	1.54	2.25	1.43	1.79	1.62	1.40	2.14
Loss on ignition	2.26	2.55	1.36	4.22	2.89	1.91	2.28	2.42	2.67	2.70
Fineness. (Average Results.)										
Residue on Sieve of 32,200 meshes per sq. in.	16.8	20.0	28.6	13.7	15.9	29.8	19.8	27.8	22.3	20.7
Residue on Sieve of 5,800 meshes per sq. in.	1.1	3.7	4.0	1.5	0.8	4.1	4.4	3.7	2.7	2.0
Strength. (Royal Laboratory Results Alone.)										
1 : 3 Mortar, normal sand, 28 days in water—					Pounds Per Square Inch.					
Tension	220	219	273	246	199	245	223	253	232	249
Compression	2,381	1,533	2,168	2,112	1,947	2,065	1,922	2,116	2,324	2,324
1 : 1 Mortar, Rhine sand, 24 hours damp air, then under water—										
28 days, tensile strength	354	300	441	374	351	371	340	374	294	340
3 months, tensile strength	464	414	569	496	381	469	383	428	349	545
1 year, tensile strength	543	563	651	680	548	592	538	562	485	653
2 years, tensile strength	552	542	603	609	536	632	623	542	492	599
1 : 1 Mortar, Rhine sand, 24 hours damp air, then in cellar air—										
28 days, tensile strength	406	440	465	465	491	515	472	489	461	455
3 months, tensile strength	548	602	531	513	585	511	495	523	469	462
1 year, tensile strength	565	788	643	518	663	597	693	685	647	626
2 years, tensile strength	590	718	813	713	915	731	976	973	880	761

From the various results it may be concluded in a general way that the method of determining the time of setting of Portland cement is badly in need of simplification.

Fineness—The values determined at the different places for fineness of grinding of the various cements agreed fairly well. At least there is no deviation of consequence. Cements C, G and J are the coarsest, leaving on the 5,000 mesh-sieve an average of 28.6, 29.8 and 27.8 per cent of their original bulk. The finest is cement D, with 13.7 per cent remainder on the 5,000 mesh sieve. The tests at the Royal Laboratory with the 5,000 mesh sieve with all the cements, and with the 900 mesh sieve in the case of some of them, gave less residue than at the other places where similar tests were carried on, which may possibly be due to the use of marbles on the fine screen and the strong agitation of the sieves. In the accompanying table the screens are given in meshes per sq. in., the 5,000 mesh metric screen having 32,200 meshes per sq. in.

Soundness—The results of all tests for soundness, either immediately after setting and hardening or up to seven days after preparing the specimens, are generally in fair agreement for the three testing establishments. Deviations which are apparent in the results of one laboratory may be referred back to delay in testing the cements as soon as received, which resulted in a much longer period of time elapsing in some places than in others before beginning the experiments. In the case of some cements which were tested at different places within a few weeks the influence of longer storage, although the samples were generally kept in the soldered boxes, is evident from the diminution in the defects in most tests for soundness, which fact is so much the less strange because apparently most of the cements were sent fresh from the grinding mills without storage.

For example, cement D, which was tested in the Royal Laboratory a week later than at one other place, passed the boiling test in the former place, while at the latter the sample showed checks on the rims and intersecting cracks and was soft. Cement F, which was tested at two places about four weeks later than in the Royal Laboratory, showed less defects after several weeks' storage when subjected to all the so-called accelerated tests. The case was the same with the brands marked H, J, L and U. These observations confirm the experience that the cements withstand the so-called accelerated test for soundness better if they have been stored.

Only a few pats of cements A and B showed warping at two laboratories, an appearance of which the cause has not been determined; several have become loosened from the glass plates without, however, showing signs of injury. The cakes of cements A, B, J and U, which were placed in the free air, have shown warping and cracked even at seven days. Marked differences in the behavior of thin and thick cakes have been observed neither under water nor in rooms nor in the free air. One member of the committee observed that pats with thin edges became soft earlier in the air. If the results of these experiments are compared with those of the accelerated tests they show essential differences.

Next to the standard test in facility are the drying and the ball-glow tests. Nevertheless, several cements have not stood the drying test, for example, brands A, F, J and U. In the case of cement U, it is noteworthy that the drying test in the Royal Labora-

tory on April 14 showed both intersecting and rim cracks, while on May 20 the cement passed the test at the other laboratories. The Heintzel ball-glow test was not everywhere passed by cements A, B, F, L and U, cement A particularly showing strong cracks at all three laboratories.

The boiling test of Michaelis was passed at two laboratories by cements C and L only. As for the rest they showed manifold signs of injury at the different laboratories, from single small intersecting cracks to complete disintegration.

The boiling test is little behind the ball test of Tetmajer. No cement was able to pass this completely. Yet, in the case of certain cements, marked indications of injury were observed only in one laboratory and generally in that in which the cement was first tested. Cements A, D, J and U acted worse.

(TO BE CONTINUED.)

PORTLAND CEMENT CO. OF UTAH.

This plant has a capacity of from 250 to 300 bbls. per day and is located in the outskirts of Salt Lake City. The cement is manufactured from rock which is brought to the mill by rail from the quarries located a few miles outside of the city, two grades of stone being used, one a high carbonate of lime and the other a siliceous limestone which are mixed to obtain the correct chemical composition in the raw material.

These works have been operated for some years. Cement was first manufactured by European methods, the rock being dried and ground up, then mixed in a wet state and made into bricks, which were afterwards dried and burned in Schofer-Aalborg continuous kilns. On the destruction of the plant by fire, June 1898, the management determined to rebuild and abandon their former system in favor of the rotary process, the reason for this change being the greatly reduced cost of manufacture and the superior quality of the product produced.

The principal buildings are of steel, covered with corrugated iron and consist of mill building, fuel building, stock house, office, and the usual auxiliary buildings. Electricity is used as the motive power, the service of an alternative current being furnished the mill by one of the local power companies in town, who generate their electricity by water power from a stream located in a canyon beyond Salt Lake City and at an elevation of over 1,000 feet above the city.

The rock is brought from the quarries just as it is blasted out and varies in size from that of an egg to lumps larger than a man's head. Upon delivery at the mill the raw material is elevated and discharged into the top of a dryer, which is a brick tower about twenty-five feet high, ten feet wide and twenty feet long, divided into two compartments for the separate dryings of the materials. The bottom is of iron, so arranged that the dry stone can be drawn out and fed into the crusher, operating continuously, while hot air is passed up through openings in the floor to dry the stone, the hot air and gases from the kilns being utilized for the drying. The heat usually wasted is led by underground flues from the rear of the rotary kilns to the dryer and then passing up through the raw material is discharged and drawn off from the dryer at the top by an iron stack, no fans are used, sufficient draught being obtained by the height of the stack. After passing through the dryer the rock is fed to a coarse crusher and reduced to an even size; from here the materials are conveyed to pulverizing machines, which still further reduces them, after which both grades of stone are deposited in steel bins, the two grades of rock being kept separate during this gradual reduction.

After careful chemical analyses the materials are taken from the bins and correctly proportioned by specially arranged elevating and conveying machinery and then carried to the finishing mills, where the materials are mixed and ground to an impalpable powder. This raw mix is then conveyed to steel storage bins over the kilns, where the material is deposited ready for burning. From these bins the material is fed into the rotary furnaces, which are heated by the use of pulverized coal which is injected into the kilns by air pressure. The coal is stored in a large storehouse outside of the mill building where it is dried and ground and then conveyed to the small bins in front of the kilns, from which it is carried to the kilns mixed with sufficient air to cause combustion. After burning, the clinker is carried to the cooling floor, where it remains until quite cool, from here it is conveyed to the grinding machines, after which the finished cement is passed on to the stock house, where it remains until it is packed and shipped.

Special attention was given in the design of this mill to eliminating, as far as possible, manual labor owing to the high wages paid in Salt Lake City, and, though small, the plant shows remarkably high efficiency and economy in the cost of manufacture.

The original installation comprised only one rotary kiln, five feet in diameter and fifty feet long, together with the necessary grinding machinery, but sufficient space was left for the installation of a second kiln and the increased grinding machinery for reducing the raw material and taking care of the finished product. The other kiln and machinery has since been installed, and the mill is operating to its full capacity.

The plant is owned principally by English capitalists, who favored the set kiln process of manufacture, and the installation of the rotary system was more of an experiment, since which time it has been operated so successfully that they contemplate enlarging the plant. The plant was designed by Messrs. Lathbury & Spackman, Engineers, of Philadelphia, Pa.

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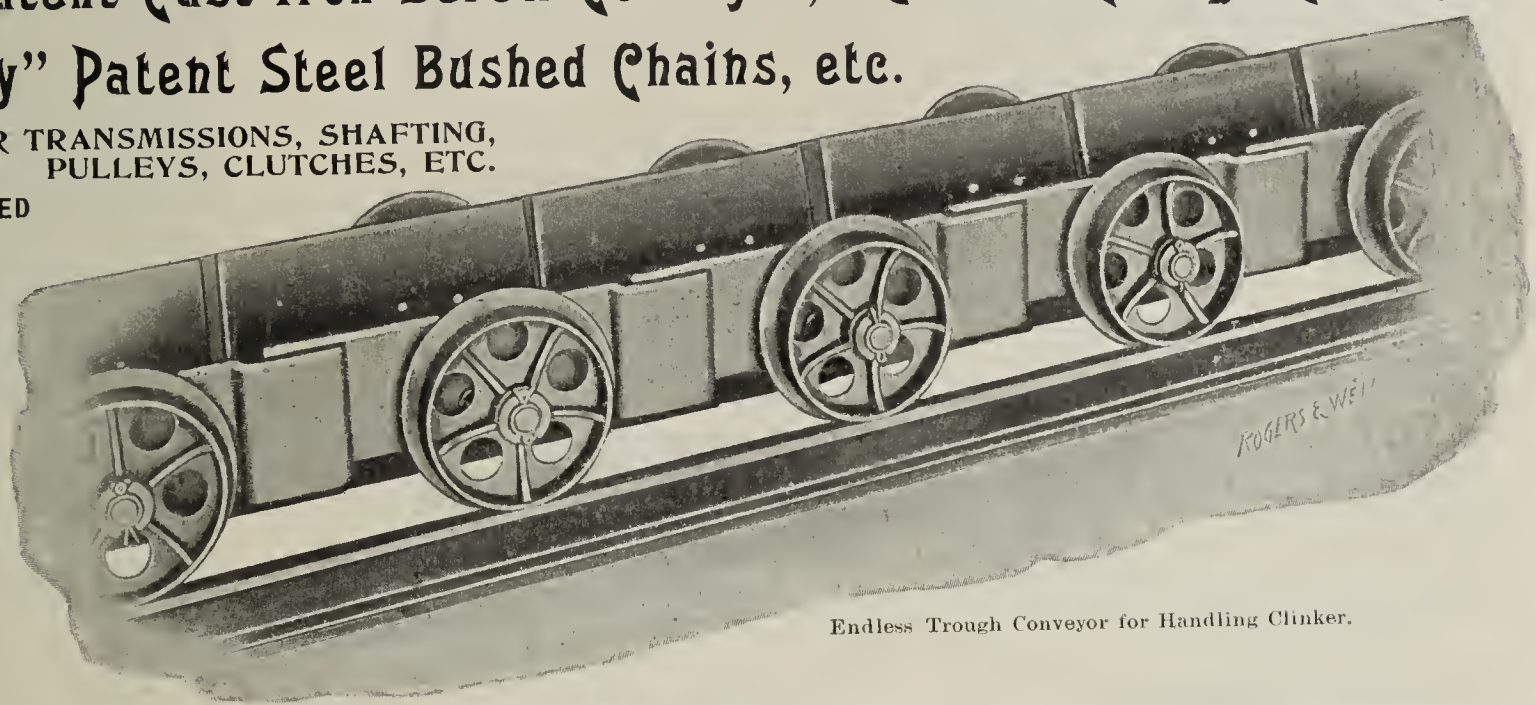

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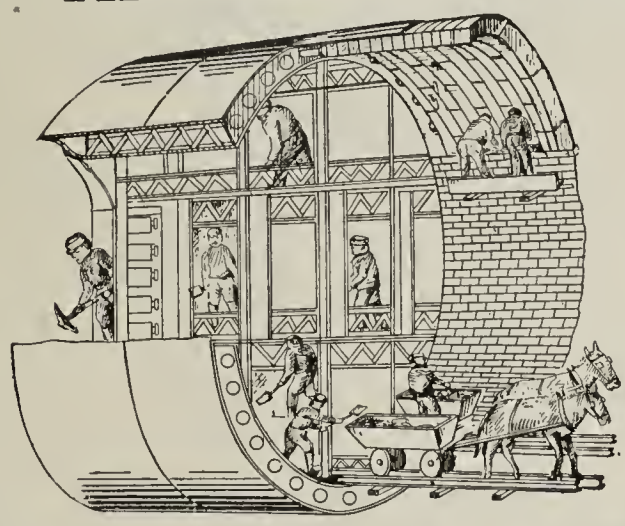

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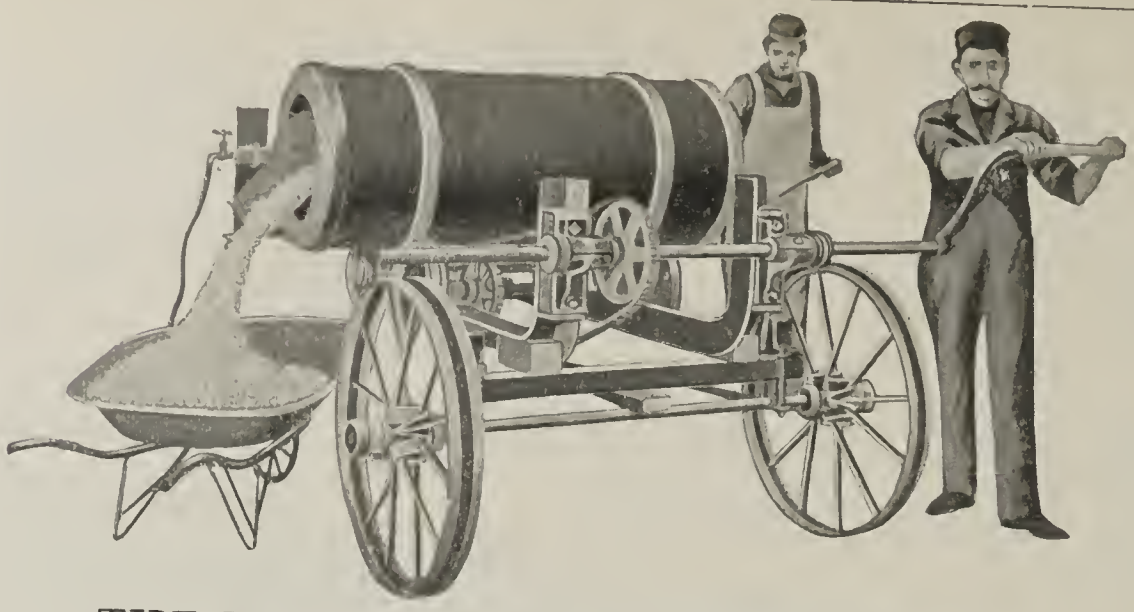

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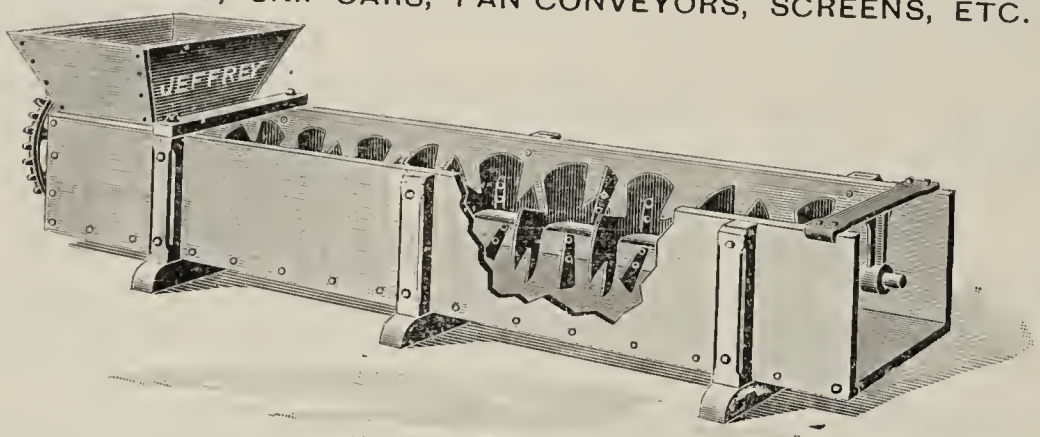

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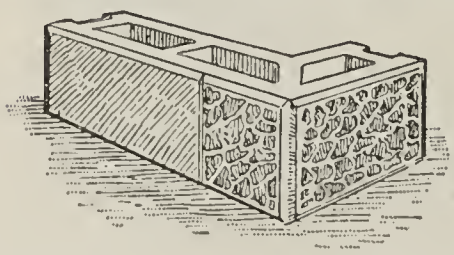

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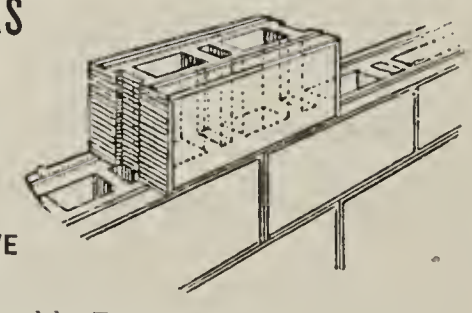

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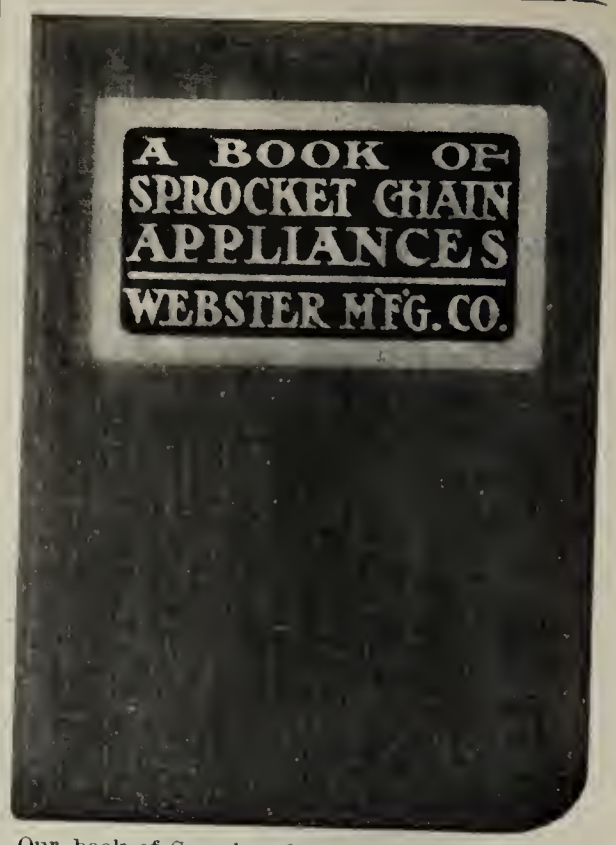

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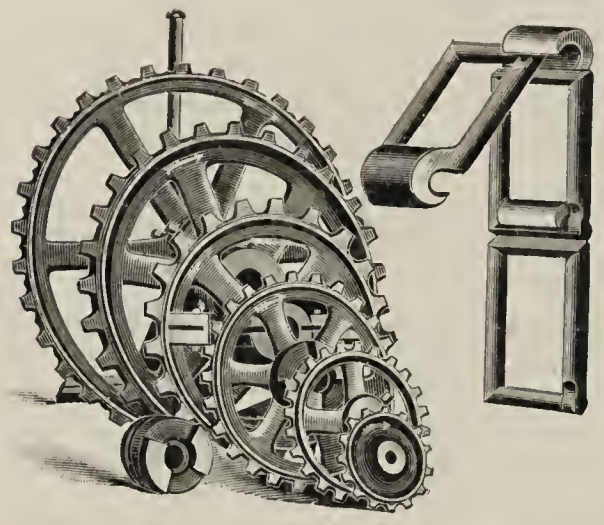

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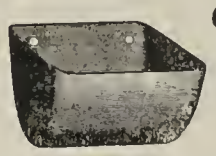

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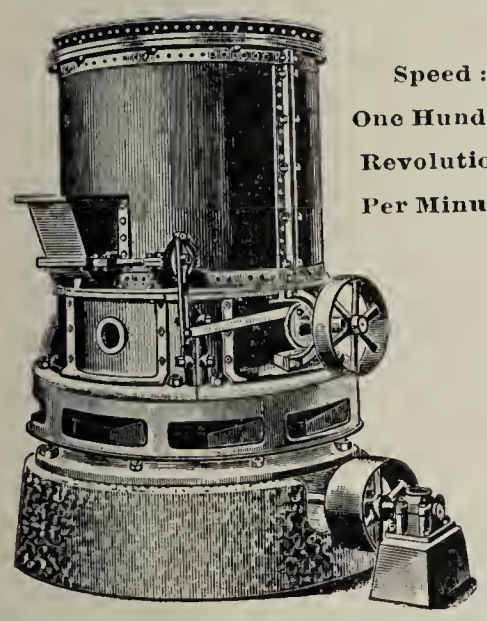

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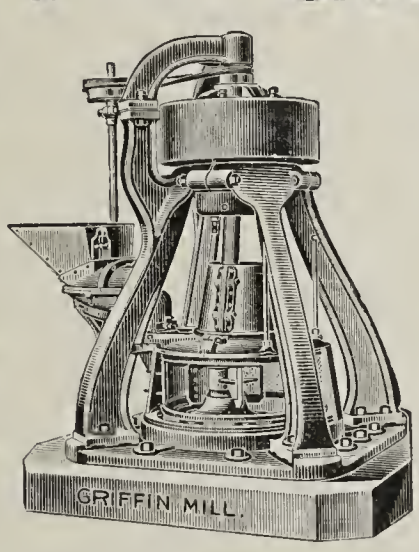

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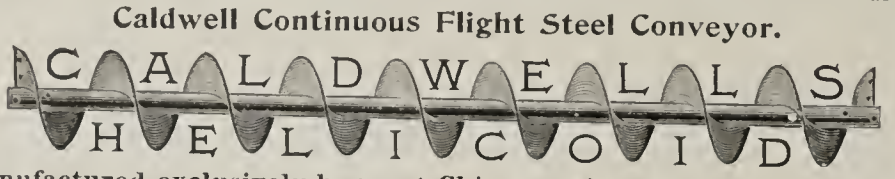

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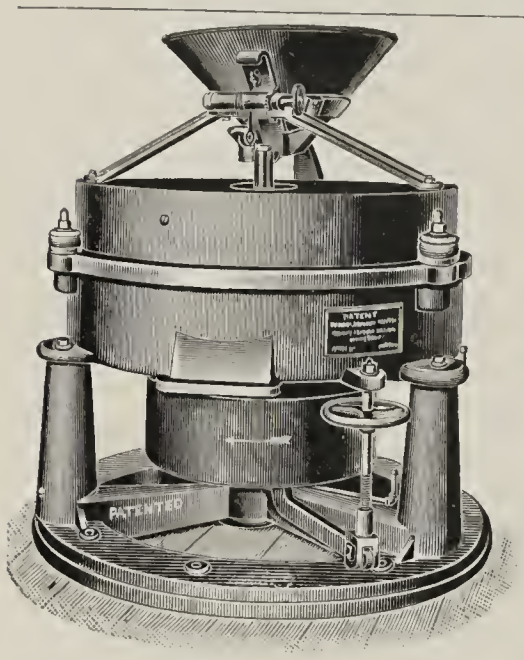

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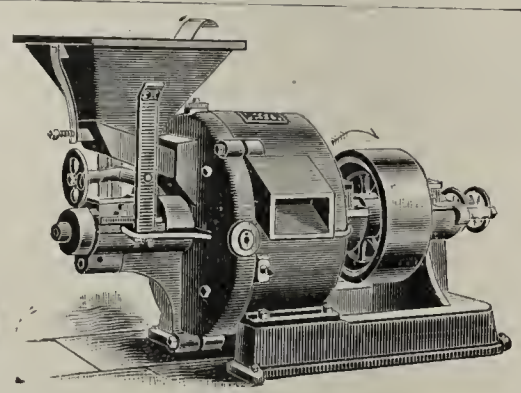

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CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and u blisher.

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

The next annual meeting of the International Mining Congress will be held at Milwaukee, Wis., June 19 to 23 inclusive. For information address T. J. Sullivan, secretary, 40 Sentinel Bldg., Milwaukee, Wis.

THE HORNE APARTMENT STORE FIRE AND TERRA COTTA TILING.

Insurance experts have made a thorough survey of the Horne store building which suffered from fire on April 8th consuming the entire contents. The building is six stories high, covering an area of 177 by 118 feet, the fireproofing was terra cotta tiling, laid in Portland cement. Mr. F. J. T. Stewart, the expert for the Continental Insurance Co., in his report to the company on the Horne store fire says: "This fire has shown that floors of hard burned tile blocks, 'end to end construction,' do not accomplish all that was expected of them. While they do not collapse, yet the lower webs scale off, thus exposing the lower flanges of the steel beams and also necessitating the expense of taking out and replacing the floor arches, even if the beams are not seriously bent by exposure of their lower flanges. The fire of 1897 in the same building demonstrated that floor arches of dense tile, 'side construction,' will allow the lower webs to scale off, exactly as those just described.

Perhaps the most important feature brought out by the last and previous fire is the disappointing action of tile floor arches in allowing the lower webs to scale off. This fact should not create over-confidence in the patent concrete floors, as they have not experienced such severe tests, while tests on sample floors have passed off satisfactorily. The ever present danger of improperly proportioning and carless mixing of the ingredients must not be overlooked, likewise the temptation to rush work during freezing weather."

The facts gathered by Mr. Stewart are clearly against terra cotta tiling as a safe fireproof material. He is cautious in speaking of concrete as a fireproof material, yet the Pittsburg fire of 1897, in which the Horne building was involved, demonstrated the fact that concrete fireproofing passed through the conflagration with little or no injury. Mr. Stewart is on the right track and the precautions he urges on properly compounding and mixing can be easily overcome by selecting only contractors of reputation to execute the work.

Compressed coke is now being manufactured in Europe. The most satisfactory process employed is to tamp the coking coal in iron boxes with removable sides which are removed when the compressed coke is deposited in place in the coking oven on the iron box bottom. This bottom is then withdrawn by means of a winch, by this means the finished coke is much more dense, the volume of its interstices being greatly reduced.

The Utica Cement Company's plant at Utica, Ill., was destroyed by fire on the 20th inst., throwing hundred men out of employment.

The Hon. C. M. Reed, of Erie, Pa., has purchased the Chautauqua Cement Works at sheriff's sale for $36,000.

Incorporated: Caledonia Portland Cement Co., East Orange, N. J., to manufacture Portland cement. Capital, $500,000. Incorporators: A. E. Knowlton, M. H. Picking, H. H. Picking, all of East Orange.

C. H. Rosecrans, C. E., 1401 Monadnock Block, Chicago, has prepared plans and specifications for a 4,000 horse-power concrete dam on the St. Joseph river at Berrien Springs, Mich., for Chas. A. Chapin. The spillway will be 400 feet long, 16 feet base. The water will have 20 feet fall, the concrete masonry will rest on hard-pan twenty feet below the river bottom.

The Star Construction Co., contractors for the 39th street intercepting sewer system of Chicago, have made an assignment. Their original bid for the work was $68 per lineal foot and $20 for the wooden lining. The next lowest bid was $140 per foot without wooden lining or $78 more per lineal foot than the bid of the Star Construction Co. The work will be finished at the expense of the contractor's bondsmen, who will sub-let the work at once.

General J. S. Clarkson, late of Iowa, now of New York, has become interested in the manufacture of Portland cement in Michigan. He is likewise interested in the $23,000,000 bridge contract between New York City and New Jersey over the Hudson river. He states that the terminal facilities in real estate will cost $60,000,000. He is likewise promoting an elevated freight railway along the wharfage front of the Hudson river from the Battery to Harlem.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	FEBRUARY.				EIGHT MONTHS ENDING FEBRUARY.			
	1899.		1900.		1899.		1900.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	9,148,000	28,686	4,727,200	17,275	86,901,179	310,311	61,402,067	243,036
Belgium..	17,751,005	47,443	9,190,076	27,000	191,393,710	579,110	181,824,685	542,932
France	297,600	1,199	297,600	1,199	5,121,200	15,630	4,023,345	14,921
Germany.....	18,668,628	65,462	19,831,187	70,187	279,376,788	954,863	319,478,518	1,136,803
All Other Europe ...	198,400	651	397,400	1,427	15,711,252	33,407	17,295,718	56,308
British North Am...	.....	... .	.....	.....	1,043,120	4,729	897,790	5,111
Other Countries.....	.....	.....	243,600	1,127	2,000	9	2,598,860	12,662
TOTAL	46,063,633	143,441	34,687,063	118,215	579,549,249	1,898,059	587,520,983	2,011,773
Domestic Exports of Cements, bbls.	3,826	8,725	7,737	14,902	23,786	50,942	47,862	98,352

There were 5,316,803 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on February 28, 1899, valued at $14,353, against 6,108,949 lbs., valued at $18,826 in February, 1900.

Imports of asphaltum or bitumen for February, 1899, were 1,881 tons valued at $7,178; February, 1900—5,182 tons valued at $12,116. For eight months ending February, 1899, 38,474 tons valued at $117,670; for eight months ending February, 1900—68,534 tons valued at $209,210.

TESTS OF THE CONSTANCY OF VOLUME OF PORTLAND CEMENT.—II.

(From *The Engineering Record.*)

CONTINUED FROM MARCH.

The hot water test of Maclay little fulfilled the cherished expectations. The assumption was warranted that the test pats which were placed immediately after making in a steam bath for three hours and then subjected to boiling for 21 hours, would show far greater injuries than the pats which were exposed to steam and water bath only after setting or double the time of setting, or even after 24 hours. This has been confirmed, however, only in slight measure or not at all. The indications of injury are almost the same whether the pat is boiled immediately after making or not until after the setting is finished.

Hence the steam boiling tests which Maclay proposes can be reduced to one-fourth of the number now necessary, or they can be abandoned entirely in favor of the boiling test of Michaelis if such a test is particularly desired. The indications of the pats which were placed after setting in fresh water and damp air of about 15 degrees Centigrade, which are made for comparative purposes by Maclay, have shown results approximately corresponding to those of the similarly conducted standard tests. Hence these tests also are superfluous. They are, moreover, hard to carry out, since it is difficult to maintain air and water for long periods of time at 15 degrees.

No cement withstood the compressed cake test of Prussing so far as made with fresh cakes. Even the compressed cakes which hardened 28 days in water showed strong warping and partial cracking on the rim as well as intersecting cracks. The tendency to warp is apparently due to the manner of preparing the cakes. This opinion is held by all members of the commission save Herr Prussing, who proposed the tests.

If it is proposed to judge the ten cements according to the accelerated tests for soundness made within the period of one week, which is the purpose of such tests, then all ten must be rejected. It would be hard to find a builder who would have the courage to use such unsound cement as those tested seemed to be if his judgment were to be based on the accelerated tests. These would therefore lead to the exclusion of cements which are very useful.

The consideration of the results of further tests will show how these cements behave in their hardening and particularly when standing for some time in the open air.

Standard Pat Tests After Storage in the Air up to Two Years.—In accordance with the general plan of procedure of the investigation the pats were examined after twenty-eight days, three months, one year and two years. The results obtained at the Royal laboratory are given in a table which shows that after 28 days many of the pats had become free from the glass plates; whether particular weight is to be paid to this may be left undecided. Apparently it is a consequence of fluctuating temperature in the storage room, and is consequently without significance in judging the tests. In general all the pats in the laboratory which lay in the room or under water show no signs of alteration up to two years. On the other hand, the pats kept in the open air show marks of increasing deterioration with increasing age, which finally are manifested in intersecting and rim cracks, particularly plain in the case of cements B, C and F. This has not been observed at the other laboratories. At the Royal Laboratory the pats lay under a roof in the open air, but on account of lack of suitable space, could not be protected at all times from the sunlight, rain and snow, which doubtless must have caused marked changes of volume in the objects, which were not made apparent in similar tests in the room. The thin and thick pats showed the same degree of failure.

The Michaelis Boiling Test—The results of the boiling test obtained in the Royal Laboratory show that there is no essential difference between thick and thin pats, although the former appear to be somewhat more sensitive. The results also prove that the cement pats which appear unable to stand the boiling at the first tests become more sound the longer the pats are kept in water. It is well known that cements which have been stored some time withstand boiling better than when fresh.

The results therefore prove that the boiling test may lead to fallacious conclusions, because it is not apparent whether the defects brought out by their agency are to be attributed to the fresh condition of the cement or to other causes. In order to decide this point, a period of at least several weeks must be allowed for testing, and on this account the boiling test is excluded from the classes of accelerated tests.

Standard Strength and Soundness After Twenty-Eight Days.—The results of tests of pieces twenty-eight days old are employed in the standard system of tests in judging of cements. This led to comparing them with the boiling and compressed pat cakes so far as these were tested at the same age. The results of the standard tests were, as already mentioned, that all cements were to be considered sound, while the results of the boiling and compressed pat cakes on the contrary was the reverse, particularly in the case of brands A, B, C, F, J and U.

The tensile tests after 28 days show only cements L and U as up to the standard; U is, however, the most unreliable cement according to the boiling and compressed pat tests. Cements D and G, which are indicated as suspicious by the boiling tests are below the standards only in compressive strength; cements F and H, on the contrary, which passed the boiling tests, satisfy neither the standard tension or compression tests.

The relation of the cements in respect to soundness as determined by the boiling and compressed pat tests and as to strength is, therefore, not governed by any law, which indeed was not expected.

The strength of all the cements varied within very wide limits and the relation of the tensile to the compressive strength is also variable, even when the average values of the results of the three laboratories are used. In addition, the results sometimes show great variations among themselves, which is to be attributed to the different methods of carrying out the tests and the varying temperature conditions. As a general thing the cements are deficient in strength from the standpoint of the standard tests.

Determination of the Changes in Length—The average values of the measurements made by the members of the commission vary so widely among themselves for each cement that the results cannot be used to draw any conclusions concerning the greater or less soundness of the samples. The opinions of the members as to the availability of the system of measuring with the Bauschinger apparatus in connection with glass or metal plates do not agree in consequence of this result, nevertheless the average results have been reported because they may possibly lead to some improvements in the method of measuring. In spite of the variations in the different laboratories, it is apparent from the results that those cements tested most often, A, B, C, D, G, and H, expand while hardening in a neat condition under water until three years old. After three months the expansion is slow. The expansion of bars of one to three mortar generally occurs somewhat until an age of one year has been reached, and then begins to disappear. The bars of neat cement U, which show marked extension even after 28 days, continue this even up to two years. Bars of sand mortar mixed

one to three showed in the Royal Laboratory more marked contraction than those of the neat cement, and this contraction generally becomes considerable after one year.

Strength of Rhine Sand Mortar—The strength of cements kept under water increases in all cases regularly up to the end of one year in 1 to 1 and 1 to 3 mortars. From 1 to 2 years age, the strength does not alter essentially in general, and only appears to have decreased in the case of cement C. These remarks apply to the average results in all laboratories; the experiments in the Royal Laboratory, given in the table in our last issue, are less favorable.

The strength of cements in mortars left three days in water and then kept in the air generally showed a quite regular increase in mixtures of both proportions and finally reached a considerable amount in some cases. Cement J suffered a decrease in strength after one year. Other cements showed fluctuations in the rate of hardening which were considerable in the case of cement C. This decrease in strength in a 1 to 1 mixture in the case of cement C was offset by only a slight increase in strength in a 1 to 3 mortar. Cements L and U also showed but a slight increase in strength. No cement, therefore showed itself as being particularly unreliable as to strength. It would be difficult to determine how far the deviations noticed are to be attributed to errors in the testing or to other causes.

In considering the strength of samples hardened in the air, it frequently occurred that falling off in the strength of a cement was observed at one laboratory which was not detected in the same time at other places. Hence it appears that particularly strong local influences have acted upon the samples for this series of tests. Warmth and dampness of the air are naturally of particular importance in the hardening of test pieces in the air, and since they are never the same in two places, the tests for strength made in different places with air-hardened samples, cannot be directly compared with each other. This influence is particularly noticeable in the case of briquettes for tension tests because their dimensions are much smaller than those for compression tests.

An average of all the tests show that most of the cements increased in strength in the air even if the progress of hardening in a few cases is but slight and during certain periods particularly after three months, apparent decreases in strength occurred. The least reliable cement in these tests seemed to be brands G and J.

If the fluctuating behavior of the different cements during the aging of the test pieces is considered as a whole, it will be vain to seek for any connection with the results of the accelerated tests for soundness. For examples cements F and H did not behave essentially otherwise in the accelerated tests than cements C and L, while in the tests for strength they were particularly noteworthy for a steady increase in hardening and C and L gave particularly variable results. It is of particular interest to note the evidence of the tests concerning the strong influence of the method of keeping briquettes on their subsequent strength. It is clear from the average results of the Royal Laboratory that the cements kept in dry air, both in fat and lean mortars, attain a considerably higher strength than those kept in water, and that up to a period of three months the strongest tests are those which are kept a few days in water and then in the air. These influences are naturally more marked in the tensile strength of lean mortars because the fat mortars give more dense masses.

Behavior of Cement Wares in the Air—All medallions, rosettes and pipe caps were well hardened, firm, and without cracks for four weeks before they were placed in the open air. Nevertheless they afterward showed many cracks on the rims and fine hair cracks, the former in the rosettes particularly and the latter in the pipe caps. The cracks on the rims occurred mainly on those tests which were put in the open air after 28 days, and were therefore kept damp longer in a closed room. In this way their intentionally fat preliminary-pouring face was more sensitive to hair cracks than the tests placed in the open air after three days.

The tendency of the rims of the rosettes to develop cracks is possibly to be explained by the particularly unfavorable distribution of the mass in these rims. On account of their projecting form they are covered too thickly by the preliminary pouring and injurious surface strains must be set up at every change of the temperature and humidity. With an increase in age the cracks have increased in a number of pieces. Hair cracks in the surface coat of the pipe caps have become marked in the case of cements G, H, J, L and U only after two years.

It appears as though the fineness of the grinding influenced the tendency toward cracking. The four coarsest cements, C, J, G and L, have the fewest cracks. This confirms the results obtained elsewhere, that cements of coarse grinding are less inclined to shrinkage cracks than those ground finer. The entire character of the cracks leads to the conclusion that in this case they are shrinkage cracks and not the result of blowing; they are due to the rapid drying of the surface skin, which is well-known to consist in most cement wares of a fat mortar rapidly covered in the open air with fine hair cracks. If a comparison is made between the number and size of the cracks on the objects made for these tests and the results of the accelerated tests for soundness, no relation will be found to exist between them. Apart from the fine hair cracks all the objects after more than two years' hardening are still sharp cut and in good condition.

Chemical Composition—If the results of the chemical analyses are compared with those of the other tests and the behavior of the cement in the open air, no connection between them is apparent.

Final Conclusions—The result of the investigation may therefore be summed up as determining that none of the so-called accelerated tests for constancy of volume is adapted to furnish a reliable and quick judgment in all cases concerning the practical applicability of a cement. The investigation has farther proved that all ten cements, which withstood the pat test in the normal system of testing, are practically constant in volume when used in test pieces and cement wares. The increase in strength of the test pieces with water and air hardening speaks well for the practical utility of the cements.

The assertion quoted early in the report that the normal or standard tests were insufficient, particularly when the cement is to be hardened in the air in its practical application, has received no confirmation by the investigation of the commission. Nevertheless the commission is ready to carry out still further investigations and requests the sponsors for the accelerated tests for soundness to provide sufficient quantities of such cements as pass the normal tests, do not satisfy the accelerated tests, and prove unsound in practical service. The cements should be sent to the Royal Testing Laboratory until October 1, 1900. Until it has been possible to discover a test for soundness which is reliable and can be carried out in a shorter time than the standard test, the pat test of the normal specifications must be retained as decisive. In the practical use of Portland cement, it is nevertheless to be recommended for such exceptional cases as require the cement to be subjected to high temperatures, that the tests be conducted under similar conditions of high temperature as the above mentioned accelerated tests.

THE GREAT NORTHERN PORTLAND CEMENT COMPANY.

The Great Northern Portland Cement Co. of Detroit, Mich., has issued a prospectus, 11½ x 8½ ins., 73 pages, illustrated with numerous engravings. The company has a capital of $5,000,000, is in strong hands financially, and owns in fee simple over 6,000 acres of marl and clay lands suitable for the manufacture of high grade Portland cement. Every step in the development of the enterprise has been carefully considered and committed to first-class experts of reputation. This shows good business tact and will tend to conserve the capital invested and insure a just equivalent for each dollar expended in the legitimate development of the enterprise. The project involves the construction of a Portland cement plant of 12,000 bbls., daily capacity, located at Baldwin, the county seat of Lake county, Mich., and to which an addition of 3,000 building lots has been platted by the company. The initial plant will have a capacity of 4,000 bbls. per day, to be gradually increased to the full capacity of 12,000 per day. The prospectus devotes a few pages defining the scope of the enterprise, with maps, plats and illustrations, showing the shipping facilities, town and mill site. The rest of the book is given up to illustrations of the practical use of Portland cement in construction work of every description. In this respect the illustrations are simply magnificent and surpass anything we have seen in the line of concrete construction from a strictly artistic point of view. The prospectus must be seen to be appreciated.

INDIANA HYDRAULIC CEMENT INDUSTRY.

The hydraulic cement industry of Indiana is concentrated in Clark county, where thirteen mills are in operation, located in the immediate vicinity of the towns of Sellersburg, Speed's, Old Charlestown and Cementville. The following list gives the name and daily capacity, in bbls.:

Speed's	3,500
Belknap's	2,700
Kentucky and Indiana	1,500
United States	1,200
Clark County	1,200
Banner	1,000
Standard	1,000
Haussdale	1,000
Indiana	800
Globe	800
Hoosier	600
Ohio Valley	600
Golden Rule	500
Total	16,400

The Black Diamond Mill with a daily capacity of 1,500 bbls. has been shut down for some time. The product of both the Speed and Belknap mills is sold through the Western Cement Association of Louisville, Ky. Five companies, The Banner, Globe, New Albany, Clark County and Kentucky and Indiana, sell through the Central Cement Company, and the others deal directly with jobbers. The Banner Cement Company manufacture the highest grade of cement in the Louisville region and receive from 7 to 10 cents more per bbl.

MONIER CONSTRUCTION BUREAUS.

The Central Technical Bureau for "Monier" constructions has been organized in Chicago by Mr. E. Lee Heidenreich, the sole representative for United States. He has established at New Orleans and Memphis the Southern Technical Bureau in charge of Messrs. Holden & Hartigan, Ltd., with offices in Hennen Building, New Orleans, and Porter Building in Memphis. The Eastern Technical Bureau is in Ellicott Square Building, Buffalo, N. Y. The Northern Technical Bureau is in charge of F. W. Cappelen, who is located in the Oneida Block, Minneapolis, Minn. The Pacific Technical Bureau is located at Los Angeles, Cal., in charge of Mr. C. Leonardt, the well known Pacific Coast contractor, who has for years been prominent in concrete constructions of every description, sugar factories, etc. We understand that the Central Technical Bureau of Chicago is being organized with a capital of $500,000, and from the work on hand and the number of inquiries from various parts of the United States indicates the enterprise will parallel the immense success of the Central Technical Bureau in Berlin, with branches throughout Europe.

CEMENT TRADE IN MONTREAL, CAN.

Stocks of cement are now light. Considerable quantities are expected as soon as navigation opens. The demand for all lines has been good so far this spring, and the outlook for the summer trade is promising. Business, however, will be principally of a small, jobbing character, there being very few large contracts in sight at present. Prices are very firm for this time of year, especially on English brands, which are quoted at $2.20 to $2.40. German brands are quoted at $2.35 to $2.55, and Belgians at $1.90 to $2.00 a barrel for new arrivals. English makers have increased prices 10 cents per cask, while freights from Belgium points have raised from 24 to 36 cents per ton.

Cement and Engineering News $2 per annum.

TRADE PUBLICATIONS.

Steel and Concrete in the Expanded Metal System of Fire Proof Construction. 7x4¼ inches, 48 pages. Merritt & Co., 1024 Ridge Ave., Philadelphia, Pa. Contents: The History of Expanded Metal, Theory of Steel and Concrete Construction, Expanded Metal Floors, Cinder Concrete, Tests by Fire and Load, Lightness, Durability and Cost with Numerous Engravings and Details of Construction. Sent on application.

Modern Methods of Lifting Water for Irrigation, Drainage, etc., a six page leaflet, 6x9 inches. Illustrated. Link-Belt Machinery Co., Chicago, Ill. The leaflet describes The Link-Belt Water Elevator, made in seven sizes with a capacity from 300 to 2200 gallons per minute, calling for from one to seven horse power, raising water from 10 to 30 feet. The leaflet illustrates the ancient Chinese method employed before the Christian era and the mediæval type of water elevator used in Mexico, in contrast with the simple and efficient water elevator manufactured by the Link-Belt Machinery Co. Copies on application.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

NEW YORK PRICES.

Demand for bricks is only fair. Common bricks are quoted at $5.50 and $6.00. American Portland cement is in good request at $2.20 and $2.35, and imported Portland at $2.25 and $2.70. Trade in other building materials is rather slack, attributed to the high prices of steel and lumber.

P. A. English of Grand Rapids, Mich., will erect the largest plaster mill in Grand Rapids.

The New York Rapid Transit Subway will require 1,500,000 barrels of cement, two-thirds of which will be Portland, as per estimate of the chief engineer, W. B. Parsons. The United Building Material Company will furnish the materials. The stone and sand used in the work will be taken from the excavation.

THE MANUFACTURE OF PORTLAND CEMENT FROM ALKALI WASTE AFTER TREATMENT BY THE CHANCE SULPHUR RECOVERY PROCESS.

By Charles Spackman, F. C. S.

(From the *Journal of the Society of Chemical Industry.*)

(Continued from March.)

In the following table the results show the $CaSO_4$ present in the cement produced by burning by different methods, a mixture containig sulphur present principally in FeS_2.

Table B.

—	Unburned Material.		Cement.	How Burned.
	$CaSO_4$ Per Cent.	FeS_2 Per Cent.	$CaSO_4$ Per Cent.	
1.	0·442	1·677	6·130	In 30-ton close kiln, with a bad draught. Whole product of kiln.
2.			5·972	As No. 1.
3.			5·902	As No. 1.
4.			5·050	As No. 1, but a very sharp draught. A high wind during whole time kiln was burning.
5.			4·778	As No. 1, but draught of kiln permanently improved.
6.			4·148	As No. 1. Sample from bottom of a kiln.
7.			5·100	In open 30-ton kiln. Whole product.
8.			3·893	In open 20-ton kiln. Whole product.
9.			3·872	In open 15-ton kiln. Whole product.
10.			4·320	From top of 15-ton open kiln.
11.			3·349	From bottom of 15-ton open kiln.

A consideration of this table will show that it is not an unimportant matter in what state sulphur if present exists in the raw materials. Taking the example given, we find that the mixture before burning contained 1.677 per cent of FeS_2. This quantity is equivalent to 3.801 $CaSO_4$, a total of 4.243 before burning, giving in the cement about 6.33 per cent of $CaSO_4$. If we take into account that derived from the coke, which, in a closed kiln of the kind used for burning cements Nos. 1 to 4, would certainly be not less than 2 per cent, we should get 8.3 per cent of $CaSO_4$ in the cement, supposing the S present combined with Fe as FeS_2 had existed in combination with lime as $CaSO_4$, or if the SO_2 evolved by the decomposition of the FeS_2 had entirely combined with lime.

The presence of 8.3 per cent of $CaSO_4$ would be fatal to the cement, and it will be noticed that it is much higher than any of the tabulated results. Evidently then a considerable amount of sulphur escaped from the kilns as SO_2, the best results being obtained in the small open kilns, there being practically no difference between those of 15 and 20 tons capacity.

The cements in Table B, with many others in which the $CaSO_4$ varied from 3 to 6 per cent, were tested against a sample containing only 2.5 per cent and their behavior carefully watched. The 2.5 per cent sample was prepared in the same manner and from practically the same materials as the other cements, by omitting a shale which contained the principal part of the FeS_2 and substituting another containing a smaller quantity.

Generally, the results were as follows: From 2.5 to about 4 per cent of $CaSO_4$, both the time of setting and the comparative strength of all the samples tested increased with the percentage of $CaSO_4$, and all were moderately slow-setting.

With from 4 to 6 per cent of $CaSO_4$ all the cements did not give good results. Those that were successful set much more slowly than the previous series, the time occupied in setting increasing with the percentage of $CaSO_4$, until with 6 per cent the cement set so slowly as to render it unsuitable for many purposes. The strength of these when tested without sand was very great at short periods of time, much greater than was the case with those containing below 4 per cent of $CaSO_4$; with sand the results were not quite so good. All the test briquettes were molded as soon as possible after the cement was ground, and in no case was any sample improved by exposure to air before being tested. It has been already explained that the effect of gypsum added in small quantity to quick-setting cement or to freshly made cement with a tendency to expand or blow, is to render it slow-setting and fit for immediate use without being air-slaked. We now see that the same effect is produced by the $CaSO_4$ occurring as one of the constituents of the cement.

The tests, some thousands in number, extended over a long period of time, and the result generally showed a high initial strength steadily increasing with age, except, of course, in the case of the samples just mentioned as not having given good results, the cause of the failure of which we must now consider.

We have hitherto assumed that the whole of the sulphur present in the cement exists in the $CaSO_4$, but this is not strictly true, as a small quantity of CaS is also always present, which is formed by the reduction of $CaSO_4$ during the calcination of the cement, which takes place in contact with the fuel. Even if only 1 per cent of $CaSO_4$ is present, CaS will also be found, and the larger the quantity of $CaSO_4$ the larger is the quantity reduced to CaS. If ordinary care is exercised in the manufacture, the quantity of CaS in cements containing up to 4.5 per cent of $CaSO_4$ is not a matter of great importance, but from 4.5 to 6 per cent it may exist to so great an extent as to entirely ruin the cement.

I found that when the $CaSO_4$ would exceed 5 per cent in the finished cement great care was necessary during the process of manufacture to prevent the formation of a dangerous excess of CaS, to which cause the failures were due. Briefly, its effects are as follows: The fine blue grey color of the freshly ground cement gradually changes to a dirty brown. This is caused by the CaS in presence of the moisture of the air reacting with the FeO or Fe_2O_2 existing in the cement. FeS first forms, this slowly oxidizes to $FeSO_4$, which is further oxidized and becomes brown. This reaction takes place much more rapidly when the cement is gauged. Samples left in air dry out a dirty brown color; if broken when dry the fractured parts are of a pale greenish blue, which rapidly becomes brown on exposure. If immersed in water the samples do not harden well, especially when mixed with sand, and become throughout of a dark green color, which changes to brown on removal from the water and exposure to air. The cement sets extremely slowly, even with a moderate proportion of water; with excess of water it will scarcely set at all, especially at a low temperature. Briquettes made of neat cement will, if allowed to thoroughly harden before being put in water, frequently possess a fair tensile strength, but with sand the strength when compared with that of ordinary cement of average quality is very low indeed.

The results of the experiments of which I have given a brief summary led me to fix the absolute limit to which $CaSO_4$ may be present in Portland cement at 5 per cent. This is considered, not as added to a normal cement, but as derived from the fuel and the materials from which it is made, the relative proportions of basic and acid constituents in the mixture before burning being arranged with reference to the $CaSO_4$ ultimately present in the cement.

Although my experiments were made with other materials and with a different object, they are equally applicable to the present case, in which we are considering the application of a material to the same purpose, the only drawback to its successful use being the presence of sulphur compounds.

The analysis of the alkali waste previously given shows that even when mixed with sufficient clay to

bring the calcium carbonate down to about 72 per cent in the dry mixture it would still contain calcium sulphate in such quantity as to largely exceed in the cement the limit I have laid down.

An experiment was, however, made in the following manner: The waste was dried and ground in the dry state with clay fairly free from calcium carbonate. The mixture was pugged with a small quantity of water and was molded into bricks, which were dried on a heated floor and afterwards burned with coke in a trial kiln. Mixtures were made with various proportions of the alkali waste and clay, the cement in each case being ground and tested separately, with the result that every one of the samples failed, although some remained sound until put in water. Clearly then it was necessary to devise some means of reducing the quantity of calcium sulphate if success was to be achieved and the following method was adopted:

A marly clay was used containing from 30 to 40 per cent of carbonate of lime. This rendered necessary the addition of a larger quantity than was used in the first experiments, and advantage was taken of the sparing solubility of calcium sulphate in water.

The materials were mixed in the wet clay, using a considerable quantity of water, and the mixture was allowed to settle for some days in tanks, when the water was, as far as possible, drained from the surface of the deposited slip. This now contained about 66 per cent of water, and after being again thoroughly mixed by stirring was allowed to run upon a drying flat heated by coke ovens, the floor being constructed of fire-clay slabs. These absorbed a considerable amount of water from the slip, which, of course, together with that previously drained from the surface, was saturated with calcium sulphate. The process is really the one originally adopted for the manufacture of Portland cement from chalk and clay which is still largely in use, and which is fully described in a paper by myself. In this case, however, a larger quantity of water was used, and the slip, instead of being allowed to settle for from six to eight weeks in backs until the water is reduced from 40 to 50 per cent, was, as time was of importance, run upon the drying flats in a more liquid condition.

In the following table of analyses, No. 1 is that of one sample of the dry slip prepared from the alkali mud and clay. The other two are for comparison with it. No. 2 is that of ordinary Portland slip or slurry prepared from grey chalk and gault clay. No. 3, the same material from white chalk and a pit clay.

—	No. 1.	No. 2.	No. 3.
Coke, water, and organic matter ..	1·032	..	..
Sand	1·349	..	1·842
Silica	12·220	12·836	13·779
Ferric oxide	3·427	2·678	3·025
Ferrous sulphide	0·324	..	..
Alumina	4·993	6·351	6·812
Calcium carbonate	71·002	76·382	73·093
Calcium sulphate	2·455	0·342	0·044
Magnesium carbonate	1·955	0·759	0·168
Potash	0·671	Not determined.	
Soda	0·772		
Water and organic matter	..		
	100·200	99·348	98·763

The dried slip was burned in a trial kiln with gas coke. The previous experiments had shown that the mixture was very fusible, and great care was necessary to prevent over-burning. No attempt was made to get good results by selecting the best clinker for grinding. The under-burned material was first picked out, as is the usual practice, and the remaining contents of several kilns were ground together.

The cement set slowly (in about 10 hours) and was tested immediately after being ground. The briquettes were made in Grant's form of mold 1-inch section, were put in water 24 hours after molding and left there until the moment of testing. They were tested in a Michele's machine, strain being applied at the rate of 400 lbs. per minute, with the following results in lbs. per sq. in.

—	Neat Cement. Water 16·3 per Cent.			1 Cement, 3 Standard Sand, Water 5·2 per Cent.		
	Highest.	Lowest.	Average of 6 Tests.	Highest.	Lowest.	Average of 6 Tests.
At 3 days	620	570	588	200	185	192
At 7 days	640	600	615	200	170	190
At 28 days	770	712	746	350	300	317

For comparison with the foregoing tests those following are given:

—	Neat Cement.			1 Cement, 3 Standard Sand.	
	3 days.	7 days.	28 days.	7 days.	28 days.
Cement A..	416	595	697	126	162
Cement B..	386	436	581	199	241
Cement C..	..	613	625	195	212
Cement D..	..	363	436	..	160
Cement E..	..	506	545	..	307
Cement F..	..	478	549	138	182

They are of six samples of ordinary commercial cement taken without selection from a register of tests.

It will be noticed that the cement made from the alkali waste far exceeds any of these in strength, both neat and with sand. This is to some extent due to the calcium sulphate, but principally to the extremely fine state of division of the calcium carbonate, which rendered possible a most intimate mixture with the clay before burning, a result not always obtained when dealing with some of the natural carbonates, except at a great, and often prohibitive cost.

In comparing these results it is but fair to remember that the tests with sand of all of those in the second table would have been much higher had the cement been more finely ground, but the strength neat, in which condition, however, cement is rarely used, would have been rather less. Any of these cements, some of which possess far less strength than that made from the alkali waste would, for many purposes, be much more suitable as they all set more quickly.

In the following table, on page 58, the analysis of four cements are given. No. 1 is that made from the alkali waste, the others are three samples of ordinary commercial Portland of very good quality. It will be observed that Nos. 2 and 3 agree fairly closely in composition with No. 1, but it must at the same time be remembered that the analysis of a cement taken by itself is no guarantee of its quality.

The results of my experiments show, that if so far free from sulphur compounds as to give in the cement calcium sulphate in quantity not exceeding 5 per cent, alkali waste may, after treatment by the Chance process for the recovery of its sulphur, be successfully utilized for the manufacture of Portland cement. With this quantity, however, the cement would set very slowly, but it could be made to set more quickly, and would be more generally useful if the calcium sulphate was reduced to from 3 to 4 per cent.

This material may be easily dealt with by the methods generally adopted for the manufacture of Portland cement from chalk and clay, but tables A and B show that as regards kilns, open ones of moderate capacity are the most suitable as the quantity of calcium sulphate in the

cement derived from the coke and the sulphides present will be materially reduced by their use.

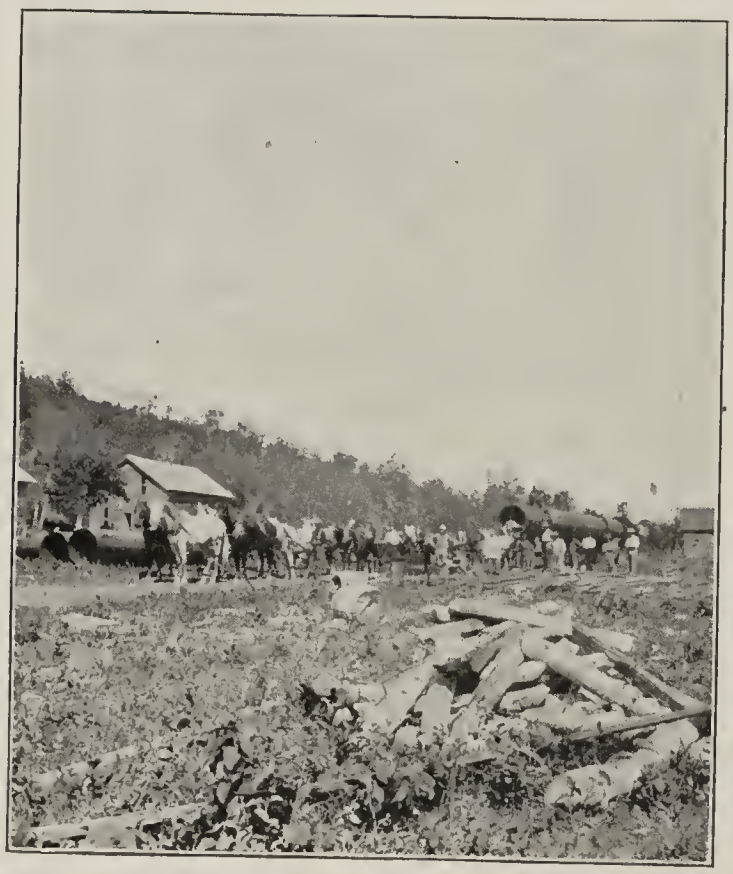
——	1.	2.	3.	4.
Insoluble residue	2·749	3·302	2·815	1·642
Silica	18·215	19·156	20·264	21·366
Alumina	8·048	7·193	7·306	8·826
Ferric oxide	6·563	4·678	6·894	4·304
Lime	56·682	56·170	56·905	60·672
Sulphate of lime	5·006	4·778	3·389	1·507
Magnesia	1·639	3·101	0·963	1·116
Potash	0·654	1·327	1·102	0·789
Soda	0·779	0·440	0·375	0·289
	100·335	100·145	100·013	100·561

THE END.

PEMBINA PORTLAND CEMENT COMPANY.

The plant of the Pembina Portland Cement Company presents no special features of construction, nor is it of much interest to those contemplating the erection of a large plant, but it is a very good illustration of the possibilities of a small plant, where the aim was, throughout, to obtain a certain given result with a minimum expenditure of money; this, too, under conditions of erection that made economical construction a difficult problem, the plant being located in Northern Dakota, nine miles from the nearest railroad, with machine shop and skilled labor entirely out of reach, requiring everything connected with the plant to be shipped for long distances and then hauled by teams to the site of the works.

The material used for the manufacture of cement is a peculiar form of limestone, resembling a soft shale in



its texture, and carrying a large proportion of clay matter. The material is found in great abundance near the locality of the works, and is, from its soft nature, easily ground, but holds a large percentage of water when first quarried, this requiring all the material to be thoroughly dried before it can be ground. The cement produced from the pure raw material is not a true Portland cement, but it can be made such by the addition of practically pure carbonate of lime. The production is about 150 bbls. per day. The average composition of the material is as follows:

Silica	12.93
Iron and Alumina	7.52
Lime	40.41
Magnesia	.55
Sulphur	3.91
Loss on ignition	34.61

This analysis was made from the dry material.

The quarries are located close to the mill and the rock is hauled to the crusher, which reduces it to pass a $2\frac{1}{2}$-in. ring. From this crusher the rock is passed through a Williams patent crusher and pulverizer, which reduces it to a fineness to pass through a 30-mesh sieve. This finely pulverized material is then fed to a tubemill, where it is finished. From the tubemill, the finished material is elevated to a storage bin above the rotary kiln.

After passing through the kiln the clinker is spread on a floor to cool. After cooling, the clinker is wheeled to a crusher and passes through the same mills used to grind the raw material, the plant being worked in alternate shifts, 12 hours on raw material and 12 hours on clinker.

The finished cement is conveyed by screw conveyors to the storage bins. Pulverized coal is used as fuel in one rotary kiln, the same dryer that is used for the raw material being utilized in drying the coal. After passing through the dryer the coal is ground in a tubemill and then elevated to storage bins.

The tubemill for coal can be utilized for grinding either clinker or raw material if desired, having more capacity than is required for the one rotary kiln.

The power plant consists of one 200 horse power high speed engine, and one 200 horse power return tubular boiler, which uses wood for fuel. In addition, the power plant is equipped with necessary pumps, heaters, etc.

The buildings are of wood throughout, the main building being 180 ft. long by 50 ft. in width. Alongside of this is built the power house as shown in the plan. All the machinery had to be hauled across the prairies and hills by teams, a haul of 21 miles being necessary on the larger pieces to avoid the steep grades and weak bridges on the shortest road from the station

to the plant, and in some places roads had to be cut to avoid steep grades.

In spite of all these difficulties the plant was erected and placed in running order in a remarkably short time, work being started on the buildings in June, 1899, and the mill was in operation by the end of October, a little over four months.

The plant was built with a view of demonstrating practically the value of the material for cement manufacture and to supply the local demand, and will probably be followed by a much larger plant in the near future. The cost of the entire plant was less than $25,000.

Owing to the small size of the present plant, and having to use the same machine for different materials, which has increased the handling, the cost of production is relatively high, and the plant as constructed is only profitable owing to the high prices cement brings in this locality, all the cement used having to be brought long distances by rail.

We show two views of the plant showing the mill and the surrounding buildings.

The engineers for the plant were Messrs. Lathbury & Spackman of Philadelphia, several of whose larger plants have been described in these columns.

Incorporated: The Grey & Bunce Portland Cement Co. of Ontario, Can. Capital $199,000.

Incorporated: The Steel Protective Concrete Company at West Virginia, with a capital of $5,000,000.

The new Convention Hall at Kansas City, Mo., in which the National Democratic Convention is to be held, will have a Portland cement roof laid on to corrugated iron.

L. C. Burris of Tishomingo, I. T., national mineral trustee of the Chickasaw Nation, is receiving bids for mining rights on 960 acres of asphalt-bearing lands on the line of the Rock Island Railway.

The Salt Creek Company has been organized at Okeene, Kan., to manufacture cement of all grades. They have secured possession of 1,280 acres of land containing some of the largest cement deposits in the United States.

At the annual meeting of the directors of the Peerless Portland Cement Co. of Union City, Mich., A. W. Wright of Alma was elected president; S. O. Bush of Battle Creek, vice-president; William M. Hatch, secretary and treasurer, and J. R. Patterson, general manager. The plant has been enlarged and greatly improved and is now running 24 hours per day.

The Mankato Hydraulic Cement Works, Mankato, Minn., started up on April 16.

The Empire Portland Cement Co. has increased employes wages from one to three cents per hour.

A Melan arch bridge will be erected over the Des Moines River on North Sixth Ave. at Des Moines, Iowa.

The Iola Portland Cement Co. has purchased 420 acres of land in the gas belt, six miles southeast of Iola, Kansas.

Lee K. Forsyth is grading a siding to connect the Michigan Central Railway with his new concrete railway fence post works at Battle Creek, Mich.

The Glens Falls Portland Cement company has erected a machine shop in connection with its new plant. It will be supplied with the latest machinery.

Incorporated: Western Cement Coating Co. of St. Louis, Mo. Capital $100,000. Incorporated by Geo. French, W. B. Harris, C. H. Wengler and others.

The Western Portland Cement Co. of Yankton, S. D., is improving and enlarging its clinker crushing department to meet the increased demand for its product.

The cost of laying cement walks has been raised at Grand Rapids, Mich., and other towns throughout the state, due to the increased price of lumber, sand and Portland cement.

The Alsen Portland Cement Co. of Germany has purchased from Clifford Bonneville 300 acres of land situated at Smith's Landing, N. Y., on the Hudson River & West Shore Railway, a large portion of which is a clay deposit adjoining the lands of the Catskill Cement Co. About 185 acres consists of a fine quality of shell limestone.

Export of domestic American cement, for eight months ending February, 1900, to Cuba, 15,426 barrels, value $28,665; Puerto Rico, 960 barrels, value $1,603; Hawaiian Islands, 1,410 barrels, value $3,186. The cement supply for the Phillipine Islands is drawn from the Green Island Portland Co., located off the coast of China, between Hong Kong and Manila, and from seven Portland cement works in Japan.

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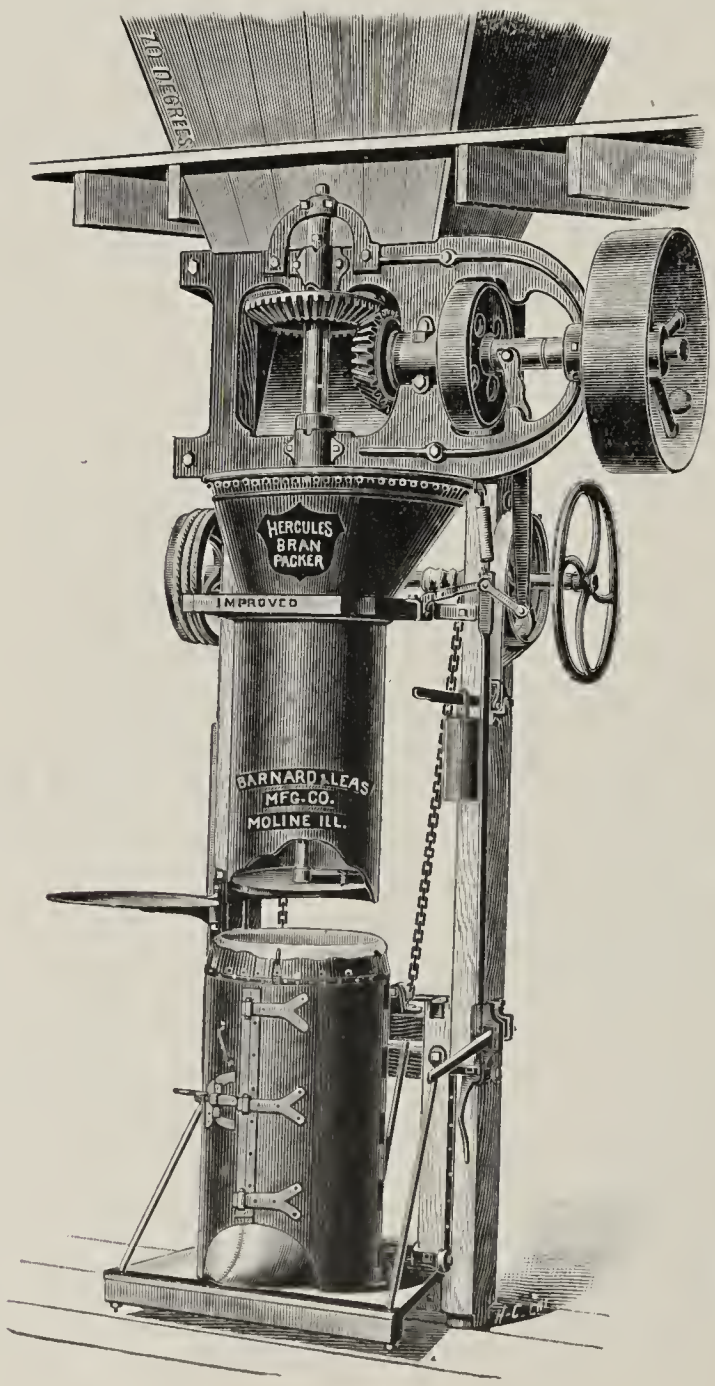

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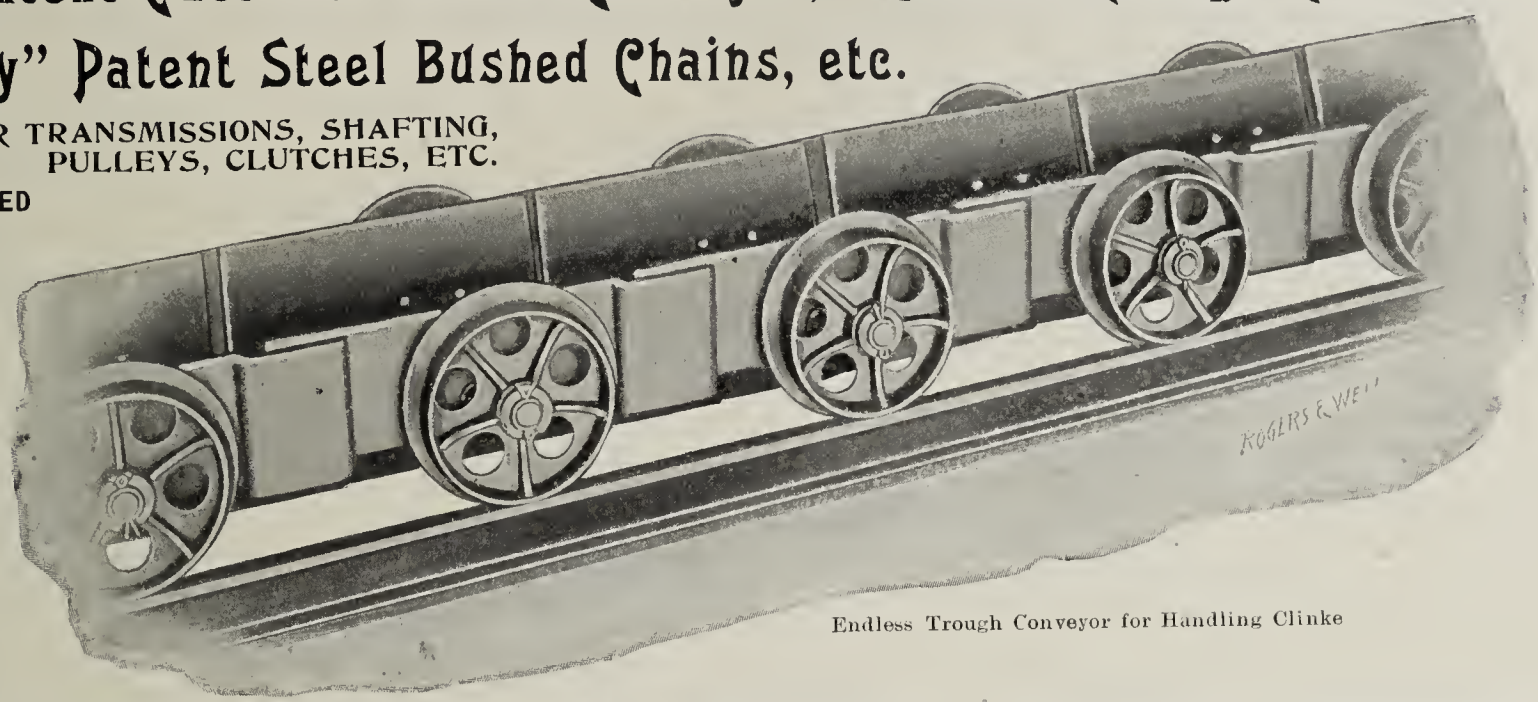

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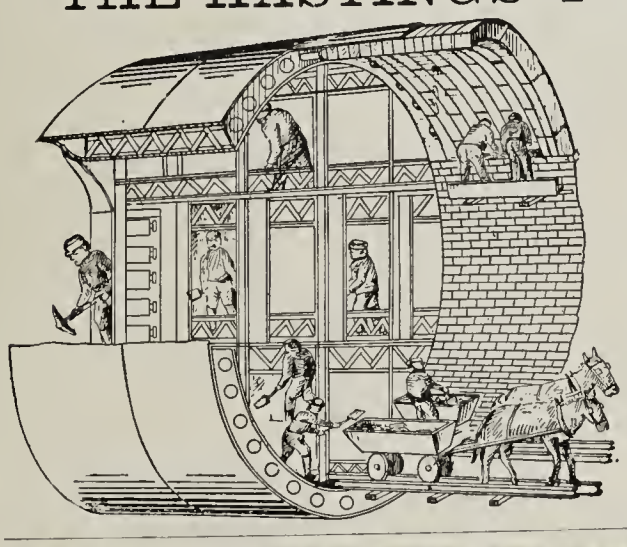

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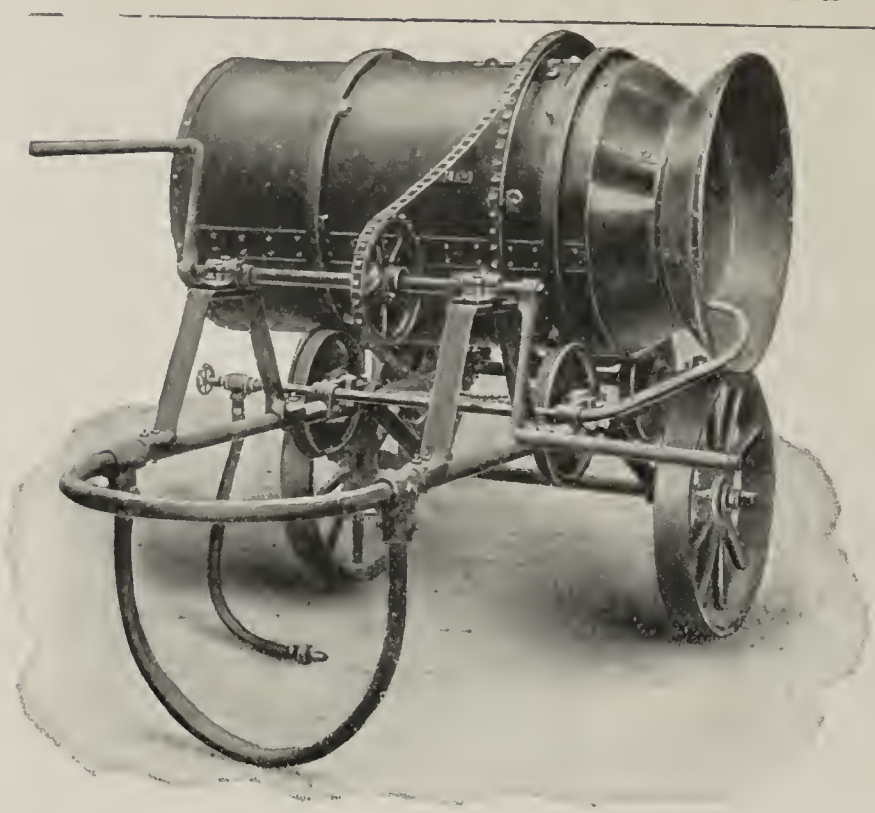

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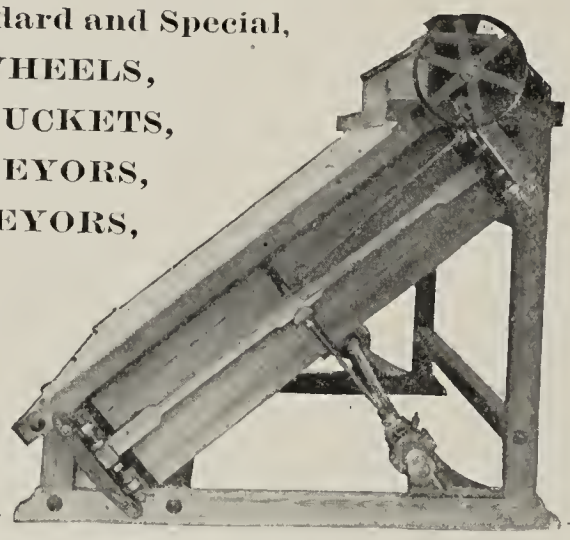

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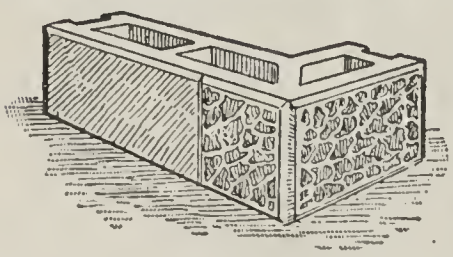

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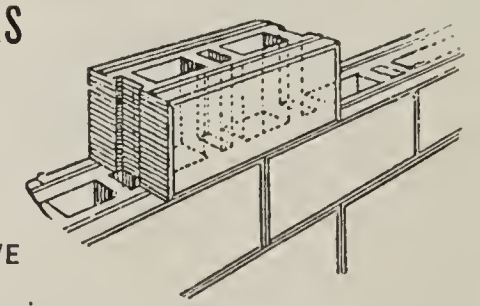

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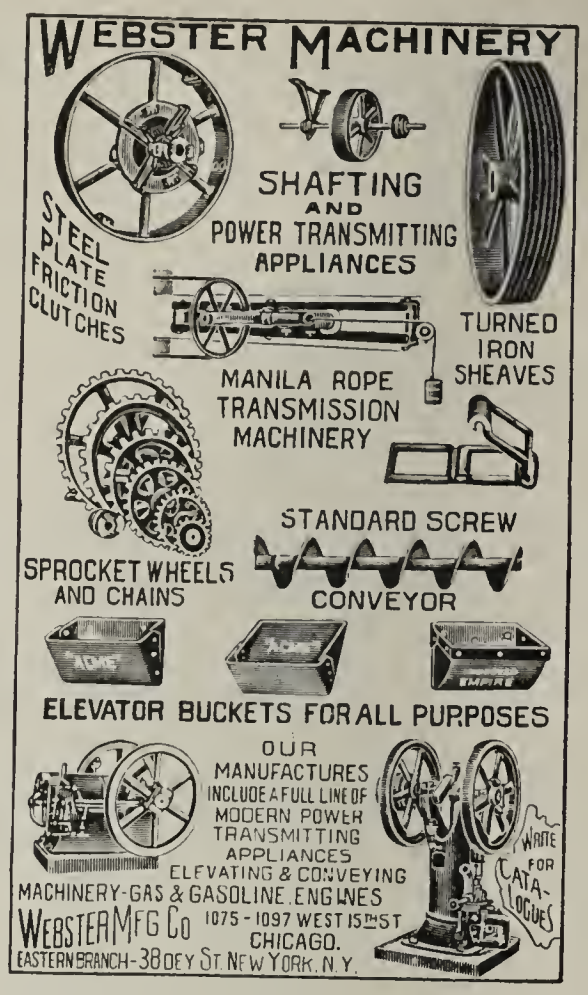

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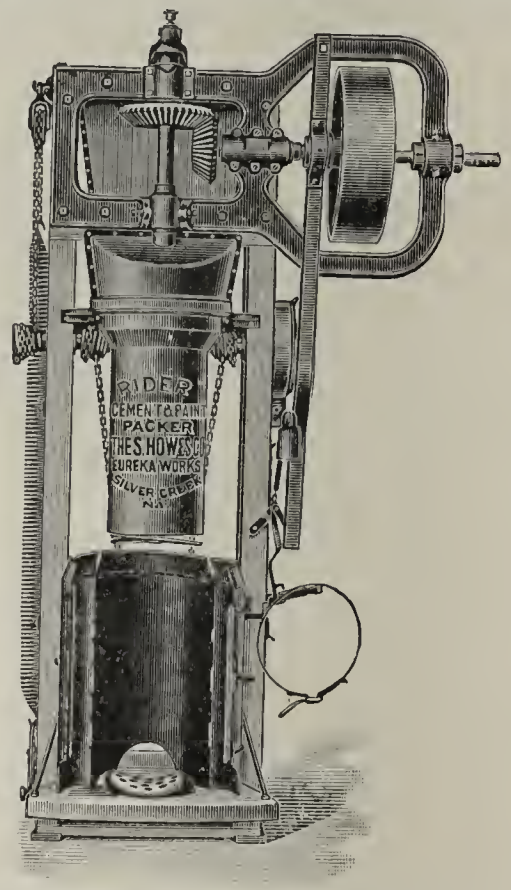

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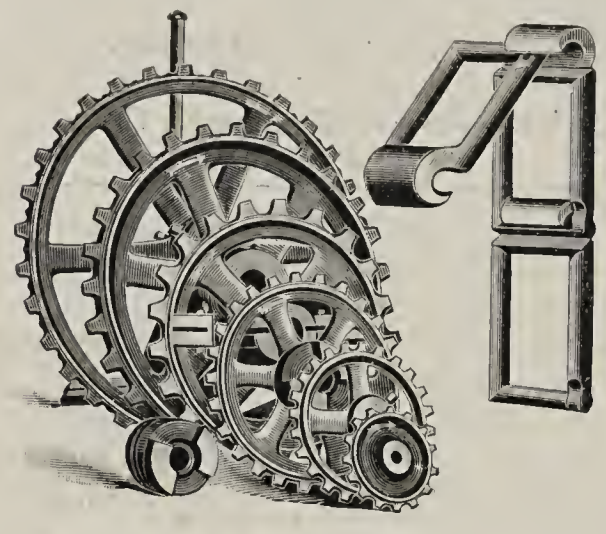

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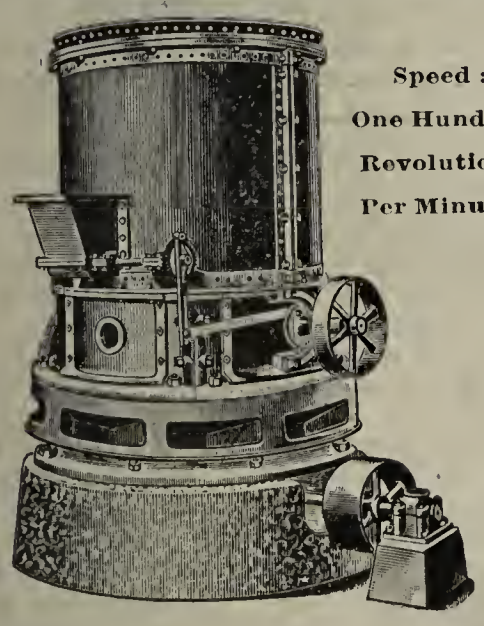

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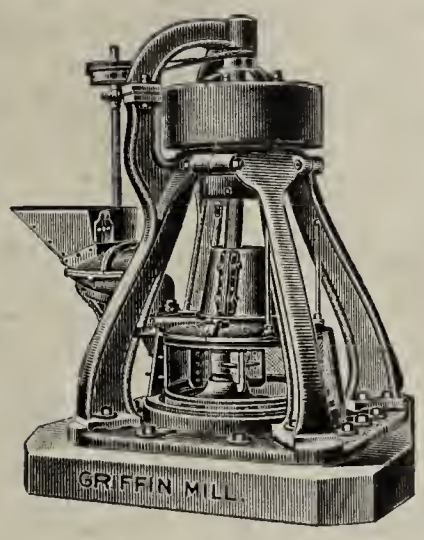

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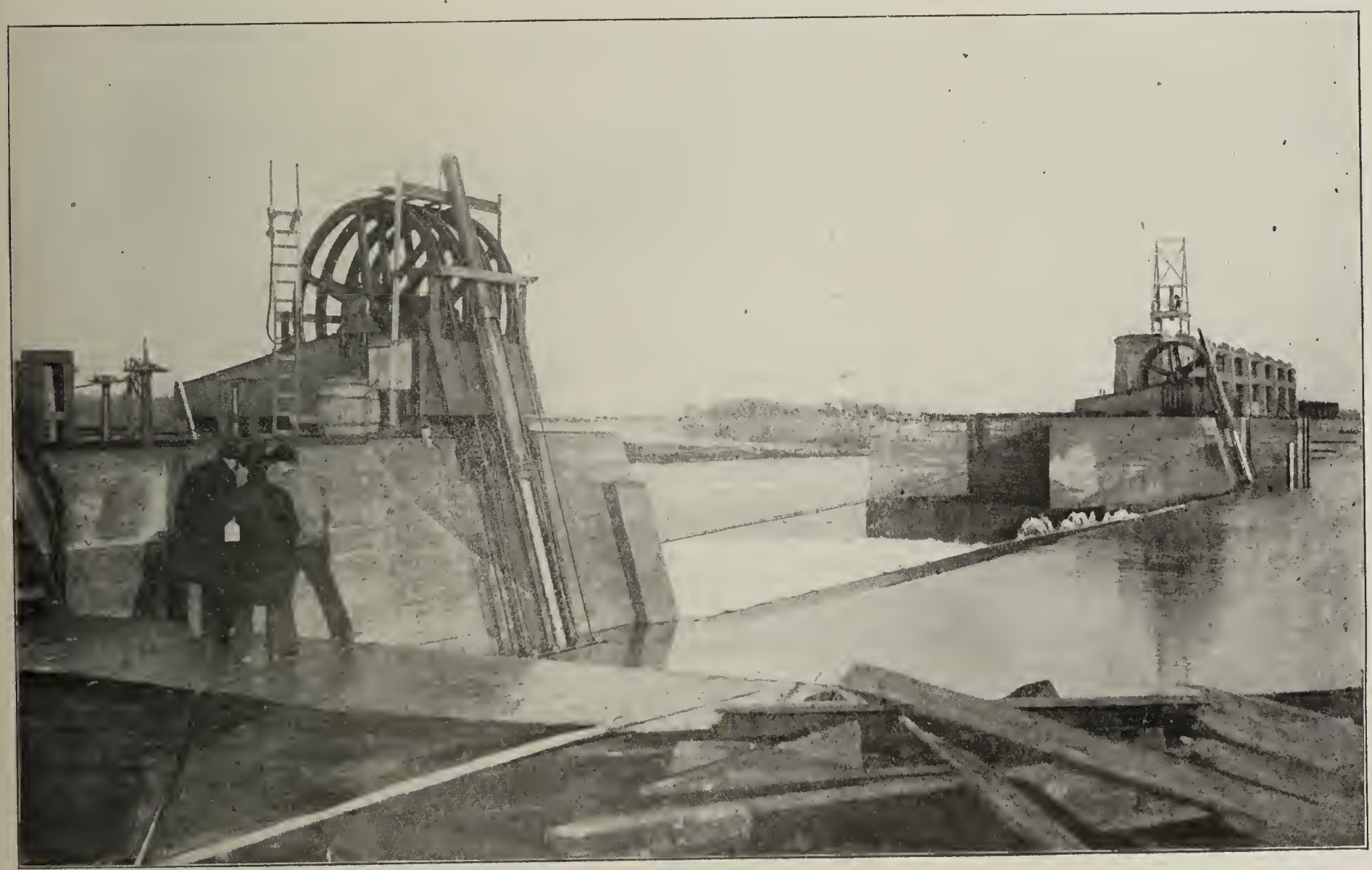

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CONCRETE CONSTRUCTION FOR CEMENT MILLS.

The time has come when the American Portland cement producer should give more encouragement to concrete construction in and about his own plant, and thereby demonstrate absolute confidence in his own product. As long as he continues to erect new works of wood, stone, brick and structural steel while he advocates the use of concrete to others for like purposes his position is illogical. It would be better to practice what he preaches by abandoning the old materials of construction and thereby bring his conduct closer in line with his present and future business interests. The many honest triumphs of engineering construction in Portland cement concrete to be found scattered through Europe were fostered, in several instances, by the liberality of the Portland cement manufacturers, actuated by a keen sense of good business tact. The European producer is ever alive to the importance of exhibiting the most perfect examples of concrete work in the vicinity of his own mills in order to educate the general public to its use, knowing the money so invested is simply bread cast upon the waters, which will continue to return in the form of new and increased orders.

Men's minds run in grooves and are prone to cling to the old methods and materials of construction and yet they are quick to sieze upon new ideas and follow them when they are based upon good plain common sense and demonstrated in actual practice.

The American mills, with few exceptions have done little to promote the use of concrete building construction in connection with their own works. This is a great fault. Every new Portland cement mill should be constructed, as far as possible, of concrete, while the old mills should see to it that all future extensions be made in this material.

We have entered upon the age of concrete. It will not do for the cement manufacturer to lag behind by clinging to the old materials in preference to concrete. We publish several books on the use of Portland cement and concrete construction, giving the product of the best European thought and practice, which we recommend to all seeking light on the subject, and especially to the American Portland cement manufacturers. Time is ripe for the development and extension of the higher scientific forms of concrete construction, of which several systems are available. These systems need substantial encouragement and should receive it. The owner of the largest system of grain elevators in the west has been compelled to send engineers to Europe for two successive years to study concrete grain elevator construction with the view to their adoption.

The American mills should extend encouragement to the promoters of the new and higher forms of concrete construction, and thereby lay the foundation to increase and widen the demand for their product.

A METHOD FOR THE RAPID GRAVIMETRIC ESTIMATION OF LIME.

(A contribution from the laboratory of the Omega Portland Cement Co., Jonesville, Mich.)

By W. H. HESS.

An accurate gravimetric determination of lime in cement materials is very important as a check on the calcimeter. The method whereby lime is precipitated as the oxalate, ignited and weighed as the oxide, is both tedious and uncertain since prolonged ignition at a very high temperature is required to completely remove all the carbon dioxide.

The following method of estimation in which the lime is weighed as the sulphate has been found to be rapid and accurate. The lime in the sample is precipitated and separated as the oxalate in the usual way, and the ignition is carried to the point of removing the filter from the residue of lime. The crucible is allowed to cool partially, when a portion of chemically pure dry ammonium nitrate, approximately equal in bulk to the lime in the crucible, and about twice as much chemically pure fused ammonium sulphate are added. A tight fitting cover is now placed on the platinum crucible and then gentle heat is applied. It has been found very convenient to incline the crucible at an angle of about 30 degrees, allowing the tip of the crucible cover to project outward and then apply the flame to the tip of the cover, gradually bringing the flame under the crucible as the reaction grows less and less violent. The re-action is comple when fumes of ammonia salts are no longer driven off. Intense ignition is unnecessary and is to be avoided. The crucible should be weighed with its cover.

It was found that if ammonium sulphate alone was used the transposition of carbonate to sulphate of lime was not always complete on first treatment. By the use of ammonium nitrate, easily fusible, nitrate of lime is first formed, which is then completely transposed to the sulphate. The nitrate of ammonium also helps to complete the ignition of the filter if any remains unburned.

Results on known samples of pure carbonate of lime are as follows:

Weights of $CaCO_3$ taken.	Weights of $CaCO_3$ recovered.
0.5003	0.4998
0.4997	0.4993
0.5012	0.5007
0.8472	0.8465
1.0037	1.0026

May 15, 1900.

The Nazareth Portland Cement Company of Nazareth, Pa., sold its plant to New York parties, for $600,000. The new owners take possession June 1. They are considering the erection of a new plant.

CEMENT.

By Edward Duryee.

[For the United States Geological Survey.]

Investigations were made under instructions from Mr. J. B. Lippincott, in order to ascertain means of lessening the cost of Portland cement in the construction of dams on the Gila river in Arizona. Owing to the remoteness of these proposed dams from lines of transportation, the expense of bringing cement to the sites makes a notable addition to the cost over construction elsewhere, and it is therefore of great importance to reduce the quantity of cement to the smallest allowable amount.

Portland cement is considered an essential element in the construction of dams subject to severe and sudden strains due to floods. It is valuable not only in giving great strength and homogeneity to the structure, but also because of the fact that exposure to moisture, which deteriorates many materials, serves to increase the strength of Portland cement mortars. It is thus being largely used for this purpose. For example, the new dam under construction on the Nile at Assuan will require 3,000,000 barrels of Portland cement, costing, in round numbers, $12,000,000.

The investigation of cement for the Gila river dams has been along three lines: (1) To ascertain whether by unusually fine grinding of the cement its strength can be appreciably enhanced and the quantity correspondingly reduced; (2) whether it is feasible to use the rocks found at the dam sites for making a sand cement; (3) whether Portland cement can be economically made at these sites.

SAND CEMENT.

Sand cement is a term applied to a mixture of cement and sand ground together in a dry state to an impalpable powder. As a rule Portland cement and quartz sand are the materials thus used. This mixture is then used with ordinary sand and gravel, as in the customary practice. The proportion of pure cement is thus considerably reduced, but the strength and durability of the concrete has been found to be nearly as great as that made with the undiluted cement. The explanation offered for the remarkably good results obtained with sand cement when used with ordinary coarse sand is that the voids in the coarse sand are nearly filled with the finely ground sand. The grains are thus bonded together and to the coarse sand by the uniformly diffused particles of the fine cement. The amount of voids in the ordinary sand, in other words, is greatly reduced by the fine sand, fulfilling the requirement for a strong mortar that it is necessary to be of dense character, the grains being of such graduated size and so well mingled as to afford the maximum contact of the surfaces of the particles.

In sand-cement mortar the grains of sand are extremely minute, the mixture being so fine that only 5 per cent residue is left on a screen of 200 meshes to the linear inch or 40,000 meshes to the square inch. The great density thus obtained contributes to the impermeability to water and increases the compressive strength and load-bearing capacity, thus rendering the mass of value for constructing foundations, dams, and sea walls.

In the tests made in this investigation a rock known as pearlite, an acidic lava or rhyolite from the Buttes dam site, was used, and also samples of quartzite from the San Carlos dam site. These were chosen because of the abundance of these rocks at the localities named and their superior hardness. The Portland cement used was that manufactured at Colton, California, this being made nearest to the place where it will be used and being sold at a lower price than other Portland cement in the local market. All of the tests were made with the same sample of cement, portions of this being taken for the several mixtures with crushed pearlite and quartzite. The sand used with the foreign cement in making sand cement was clean beach sand from dunes along the coast.

Test of Sand Cements.—Results of the tests of the sand cements and comparisons with other mixtures are given in the following table. In each case the crushed pearlite was mixed with an equal weight of cement and the mixture was ground in a mortar until it all passed through a screen having 200 meshes to the linear inch. The same method was pursued with the quartzite from San Carlos, thus making sand cements composed of equal parts of Portland cement and pulverized rock ground to an exceedingly fine condition.

The coarse sand used in making the mortar with the sand cement and with the pure (Portland) Colton cement and was of the ordinary grade of fineness used for making cement tests. It was screened from ordinary gravel, all residue on the 20-mesh screen being rejected and all left on the 30-mesh screen being retained.

The briquettes for testing were made according to the specifications recommended by the American Society of Civil Engineers. After the briquettes were made they were kept under a damp cloth for twenty-four hours, then placed in vats of water, where they were left until the time for breaking arrived, namely, seven days or twenty-eight days. The fine grinding and diluting of the Portland cement with fine sand did not materially affect the time of hardening or setting. The beginning of the setting process of the ordinary Colton cement mortar, or initial setting, was thirty-three minutes, and the time of final setting was eighty-five minutes. This applies to samples Nos. 3, 4 and 9 of the following list. The corresponding periods for the sand cement were thirty and eighty minutes. The cement mortar continues to harden and increase in firmness for a year or longer.

Comparison of test No. 3 with No. 5, and of No. 4 with No. 6, shows that increased fineness of grinding very materially increases the strength and sand carrying capacity of cements. The ordinary Colton cement of tests No. 3 and No. 4 was ground finer than commercial Portland is usually ground. Recent improvements in

Results of tests of Portland sand cements.

No.	Material.	Sand.	Portland cement to sand.	Fineness.			Water.	Strength.	
				50 mesh.	100 mesh.	200 mesh.		7 days.	28 days.
				Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Lbs*	*Lbs.*
1	Colton and Butte pearlite, 1 to 1	2	1 to 5	0.00	0.00	0.00	10	80	300
2	Colton and San Carlos quartzite, 1 to 1	2	1 to 5	.00	00	00	10	90	345
3	Colton, regular	2	1 to 2	.42	7.20	33.20	10	170	385
4	do	3	1 to 3	.42	7.20	33.20	10	140	240
5	Colton, fine ground	2	1 to 2	.00	.00	(a)	12	370	465
6	do	3	1 to 3	.00	.00	(a)	12	170	260
7	Colton and Butte pearlite, 1 to 1	3	1 to 7	.00	00	00	10	75	155
8	Colton and San Carlos quartzite, 1 to 1	3	1 to 7	.00	.00	.00	10	55	185
9	Colton, regular	0	1 to 0	.42	7.20	33.20	18	615	660
10	Imported	0	1 to 0	.80	7.80	29.33	18	345	525
11	Imported and sand, 1 to 1	2	1 to 5	.00	.00	.00	10	115	190
12	do	2	1 to 5	.00	.00	(a)	10	125	185
13	do	3	1 to 7	.00	.00	(a)	10	55	90
14	do	3	1 to 7	.00	.00	.00	10	90	140
15	Imported, regular	2	1 to 2	.80	7.80	29.33	10	210	270
16	do	3	1 to 3	.80	7.80	29.33	10	120	175

a Some left on 200-mesh screen.

Note.—The above cement stood the boiling test for free lime satisfactorily.

mills for grinding render possible a reduction in size of cement grains at a cost which is small when compared with the great increase in the value of the resulting material. Where the freight charges are high, as is the case at the locations under consideration, it is especially important to take advantage of this improvement, and there is no doubt that if the specifications call for a fineness such that only 1 per cent is to be left on a 100-mesh screen, the manufacturers will respond to the requirements. Engineering specifications have ordinarily allowed a residue of 5 per cent on a 50-mesh screen, although manufacturers have for some years permitted a residue of only 1 or 2 per cent on a 50-mesh screen.

CRUSHING TESTS.

In order to obtain the crushing strength of the various cements and concrete considered, two 1-inch cubes of each were broken. The results given are the averages of the crushing strength of the two cubes. The cubes were allowed to remain thirty days in water and then thirty days in the air.

CRUSHING TEST OF 1-INCH CUBES.

Character of mixture.	Water.	Average crushing strength.
	per cent.	Tons.
Standard Colton cement	18	3.25
Colton cement, 1 part, and ordinary testing sand 2 parts	8	1.75
Colton Cement, 1 part, and marble sand, 2 parts	8	2.38

Crushing tests were also made of 6-inch cubes of concrete after these had been immersed for thirty days in water. The portions of the mixture and the breaking strain in tons are given in the following table. In the mixture the proportions are given by volume and not by weight.

CRUSHING TESTS OF 6-INCH CUBES.

Character of mixture.	Breaking strength.
	Tons.
Colton cement, 1 part; ordinary sand, 3 parts; pebbles from gravel, 6 parts	38
Colton cement, 1 part; sand, 3 parts; crushed marble, 6 parts	30
Colton cement, 1 part; sand, 2 parts; crushed marble, 5 parts	20

It is believed that concretes of approximately equal value can be obtained by using cements in the following proportions, measured by volume:

Portland cement, 1; sand, 3; broken stone, 7.

Sand cement, 1; sand, 2; broken stone, 6.

Cost of Sand Cements.—In the Portland cement concrete made in the proportion of cement 1 part, sand 3 parts, and broken stone 7 parts, it has been found that 270 pounds of cement will be required for a cubic yard of concrete. This, at 2.12 cents per pound, will cost $5.72 per cubic yard.

In the sand cement concrete of the proportions 1 cement, 2 sand and 6 stone, 340 pounds of cement would be required for each cubic yard of concrete. This, at 1.2 cents per pound, would cost $4.08.

The saving in the cost of cement to be effected by using sand cement instead of the Colton Portland will be the difference between $5.72 and and $4.08, or $1.64 per cubic yard of this concrete entering into the construction of the dam. From the total saving thus realized should, however, be deducted the cost of the plant required for grinding the sand cement.

Concrete blocks composed of the above proportions were crushed at McGill University in 1898, with the following results:

Sand cement, 1; sand, 2; broken stone, 6; water, 20 per cent.

Weight per cubic foot, 154 pounds. Crushing load, in pounds per square in.: Seven days, 521 pounds; twenty eight days, 639 pounds; sixty days, 670 pounds.

A concrete of German Portland of the proportions of 1 cement, 2 sand, 6 broken stone, and 20 per cent water stood a load of 728 pounds per square inch in twenty-eight days, and one of the same proportions made from English Portland stood 698 pounds in twenty-eight days.

Tests for crushing strength on 6-inch cubes of concrete, made of 1 part sand cement, 2 sand and 3 parts gravel, were made on concrete that was taken from the bucket just as it was ready to be laid in the foundation of the Cathedral of St. John the Divine, in New York city. Each result is the average of the crushing strength of four separate cubes, made under exactly the same conditions at different periods:

7 days old crushed at	77,162
14 days old crushed at	83,225
30 days old crushed at	92,465

Approximate cost of plant for making sand cement; capacity, 240 barrels per twenty-four hours.

Crusher (required also for crushing rock for concrete)	$2,000.00
Mill for coarse grinding	2,000.00
Tube mill for finishing	2,500.00
Engine and boiler	1,500.00
Setting up machinery	1,000.00
Buildings and bins	1,000.00
Total	10,000.00
Cost of mill, per bbl. of cement.	.20
Add for concrete making a power mixing machine	1,500.00

In making concrete, if a good quality of stone be used, and the rock be crushed so as to be well graduated as to sizes, thus securing a minimum of voids, the compressive strength of the concrete increases as the proportion of stone increases and as the volume of voids between the stone decreases, and decreases as the proportion of sand in the mortar increases. The rule, therefore, holds that, to secure the greatest strength, mix the maximum quantity of stone with a minimum of sand mortar sufficient to bond the stone together, the sand mortar being rich in cement. An extensive bed of exceptionally good sand for mortar was found near the Buttes, the grains graduating in size from very small to large sizes. It shows only 35 per cent of voids, while the standard cement-testing sand used in laboratories has 45 per cent of voids.

A large tube mill will grind 10 barrels of sand cement per hour to the requisite degree of fineness, at an estimated cost of 20 cents per barrel. The cost of power for grinding is calculated at 3 cents per horse power per hour at the dam site.

Cost of sand cement with Portland cement at $8 per barrel:

One-half barrel Portland	$4.00
One-half barrel crushed and coarse-ground quartzite	.18
Grinding same in a tube mill	.20
Royalty on account of sand-cement patent	.05
Total cost of sand cement per barrel (375 pounds)	4.43

The cost of sand cement per pound, quartzite being used as the source of the sand cement, would therefore be 1.2 cents.

The cost of the mill per barrel of cement, 20 cents, is not included in the above.

It is estimated that the cost per barrel of Colton Portland cement, delivered at the dam site will be $8. This, for 375 pounds weight cement, would make the cement cost 2.12 cents per pound.

USE OF ROCKS AT THE DAM SITES.

For the purpose of ascertaining whether the rocks at the dam sites could be used in the manufacture of Portland cement the localities were visited and samples were obtained of those rocks which occurred in sufficient quantities to furnish a supply necessary for manufacturing the large amounts of cement needed. In looking for the raw materials it must be borne in mind that, chemically considered, Portland cement consists of a compound of tricalcium silicate and dicalcium aluminate, accompanied by small percentages of ferrate and sulphate of lime and traces of alkalies. It is made by grinding and burning together either natural or artificial mixtures of carbonate of lime and silicate of alumina. Limestones, chalks, or marls usually furnish the carbonate of lime, and clays are the ordinary source of the alumina and silica. The mixtures are burned at a high temperature to a blackish clinker of a semi-vitrified character. After cooling, this clinker is reduced by grinding to an impalpable powder, which form it is known by the generic name of Portland cement.

Rocks at Riverside Dam Site.—

Limestone (No. 3 in the following table) was obtained near Riverside, on the road to the Pioneer mill, where it is found in large quantities, along the roadside. The rhyolite (No. 4 in the following table) was found 2 miles south of the Riverside site. It offered the closest approach to a suitable silicate of alumina that could be found.

The source of elements of silica and alumina in the crude materials should, however, be sedimentary in character, not igneous or metamorphic. The analysis justified a trial mixture and therefore one was calculated and made, but on burning the materials failed to effect the requisite combination for a Portland cement. Too large a percentage of the silica was in the free or uncombined condition. Fuel was not to be found near the Riverside site, and the manufacture of cement at this place is considered impracticable.

Analyses of rocks from the vicinity of the dam sites.

[Chemical composition, in percentages.]

No.	Name.	Color.	Locality.	Sp. gr.	Carbonate of lime, $CaCO_3$.	Carbonate of magnesia.	Silica (SiO_2).	Alumina and ferric oxide.	Moisture.	Lime per cent in the carbonate of lime.
1	Limestone	Gray	San Carlos	.....	96.65	0.00	1.4	1.3	0.65	54.124
2	do	Pink	do	2.709	55.92	31.00	3.7	6.0	1.00	31.315
3	do	Blue	Riverside	.....	93.10	0.00	4.7	1.4	.....	52.136
4	Rhyolite	White	do	1.541	9.60	.....	60.9	12.6	16.90	5.376
5	do	Pearl	Buttes	2.361	.....	.....	.....	.....	.....	.....
6	Limestone	Blue	Queen Creek *a*	2.81	90.10	0.00	4.1	5.8	.....	.....
7	do	Gray	do	2.678	55.50	0.00	34.6	1.3	.....	31.08

a From about 1½ mile above dam site.

Rocks at San Carlos Dam Site.—The limestone from San Carlos site (No. 2 in the following table) was found to be admirably adapted to the purpose of the dam construction on account of its good specific gravity (which was 2.7), freedom from flaws, and siliceous character. It occurs in vast quantities, forming the abutments at the dam site. It forms bluffs, extending for several hundred feet, well located for quarrying. Large massesmay be embedded in the concrete, care being taken that they be laid irregularly in the mass of the dam, and are well placed so as to bond into a monolith.

The analysis of the gray or bluish limestone (No. 1 in the above table) shows from its freedom from magnesia and the small percentage of free silica that it is possible to make a Portland cement with it, provided a suitable clay can be found to furnish the requisite elements of silica, alumina, and ferric oxide.

Fuel—An extensive, undeveloped deposit of bituminous coal is located about 17 miles from San Carlos dam site. There is a wagon trail to within about 6 miles of the coal beds, but after leaving the wagon trail the only means of access was found to be a bridle path over the hills. About ten years ago numerous prospectors' locations were maee in the district, and shafts were sunk at a sufficient number of localities to prove the deposit to be of considerable extent. Most of the shafts have become filled with debris, but several were entered to depths of 15 to 30 feet. They showed the body of coal to be in beds having a dip of about 60 degrees, the beds being from 5 to 10 feet in thickness, not of solid fuel, but showing seams of good coal interlaid with seams of slate and waste. In the bottom of the deepest shafts was found a good body of coal in a solid bed perhaps 5 feet thick. It was reported that at the time the prospecting was done on the claims some 30 tons were transported by wagons to the Southern Pacific Railroad and used in the locomotives, but that the cost of mining and transporting it to the railroad, with the crude means available at the time, was about $20 per ton.

Cement could be burned with coal. The right to mine the coal for the use of the government in this work could be secured readily and at a nominal cost. The cost of mining and transportation to San Carlos would, however, be high. In general practice 120 pounds of coal dust are used in burning 1 barrel of Portland cement.

Taking as a basis coal delivered at the dam site at $10 per ton, limestone at 40 cents per ton, and clay at $1.25 per ton, the cost of manufacturing Portland cement at the dam site would approximate $2.75 per barrel. The cost of erecting a plant with an output of 300 barrels of cement every twenty-four hours would be $75,000. Supposing the amount of cement to be required in the construction of the dam to be 50,000 barrels, the cost per barrel, if made at the site, would be approximately as follows: First cost of plant, $75,000; cost of manufacturing 50,000 barrels, at $2.75, $137,500: total cost $212,500; cost per barrel, $4.25.

With reference to the degree of reliability to be placed upon Portland cement made in new localities, it may be said that the manufacture of this material has been put upon a scientific basis, such that the manufacturing chemist can predict the grade of cement to be made from the given materials and, by means of analyses of various rocks, can calculate suitable mixtures to produce the required result. The uniform system of testing cements recommended by the American Society of Civil Engineers affords a reliable means of determining the intrinsic merits of the product. The old method of buying cements on the reputation of the maker has been succeeded by tests for determining the actual value. Portland cements of American make are being extensively manufactured and are of equal or even superior quality to the foreign-made cements. During the year 1899 it is estimated that 6,000,000 barrels of Portland cement have been used, of which four-fifths were of home manufacture. In spite of this fact, on account of the failure to find suitable clays at the various localities and also the difficulty of obtaining fuel, it is impracticable to manufacture Portland cement at the dam sites.

It is important, if Portland cement is used at the localities under consideration, that the specifications should require it to be ground so fine that not over 1 per cent residue shall remain on a 100-mesh screen.

Reliable sand cement can be made from the quartzite at San Carlos or the pearlite at the Buttes dam site by grinding with Colton (Portland) cement. A saving will result at the San Carlos dam site of $1.64 per cubic yard by making sand cement on the ground, this being exclusive of the cost of the plant for grinding.

Pittsburg is considering the erection of a filter plant to cost $2,500,000 or over. The specification calls for 23,200 cubic yards of concrete in the walls, figured at $127,000, and 23,700 cubic yards for the floors and drains, figured at $142,000.

The Hasting's Tunneling Shield, working on the 24 foot 9 inch bore of the Thirty-ninth street intercepting sewer of this city, made 10 feet per day in each heading during February and 650 feet from March 1 to April 9, exclusive of six days devoted to repairing surface plant and a general clean up of the tunnel. The shield working east from the central shaft encountered a strata of block quick sand which made it difficult to prevent leakage of compressed air in this heading. The engineer in charge, considering the difficulties encountered, regards the progress as very satisfactory.

THE BEAVER PORTLAND CEMENT COMPANY.

Stimulated by the rapid increase in the use of Portland cement in all engineering work, and encouraged by the almost phenomenal success of this industry in the United States, it was only to be expected an effort should be made to establish and foster the manufacture of Portland cement in Canada, as it is, to a certain extent, cut off from the most natural source of supply by the heavy duties imposed on all cement imported from the United States.

Fig. 1.—Frame work of coal drying building and coal dryer under erection.

During the past ten years several small works for the manufacture of Portland cement have been built in Canada, which followed, as a general rule, the method of manufacture employed in England. These, with but one or possibly two exceptions, failed as a commercial success, which failure was largely due to the want of experience on the part of those engaged in the industry, and to poor design and mistaken methods of manufacture adopted, so that to-day there are but two plants in Canada that are manufacturing more than two hundred barrels per day of Portland cement. These are the works of the Rathbun Company of Deseronto and the Beaver Portland Cement Company at Marlbank, Ontario, and in presenting the following description of the latter plant, we think it illustrates the greatest advancement made in the industry by Canada.

The plant of the Beaver Portland Cement Company was formerly known as the London Portland Cement Company (Limited) and the works were originally started in a very small way, manufacturing cement from the marl and clay by the English method, using one intermittent bottle kiln. Sufficient success from a financial standpoint was met with originally to encourage the enlargement of the works and about one hundred thousand dollars was spent in altering and increasing them. A Hoffman kiln was built, compound condensing engines installed and a large amount of machinery imported from England, but the renewed and enlarged plant proved an utter failure, and after being finally shut down stood idle for several years until the fall of 1898, when a party of Philadelphia capitalists bought out the English interests and employed Messrs. Lathbury & Spackman, consulting engineers and cement experts of Philadelphia, to remodel the plant and put it in good condition.

Work was started in November of 1898 and designs prepared for installing two rotary kilns to burn the marl and clay by the wet process, using powdered coal as fuel. A fireproof kiln building one hundred and twenty feet long by fifty-five feet in width was erected; also a raw material building, fuel building, etc. Considerable modern machinery was installed for finishing the cement, but the old power plant and a portion of the cement machinery was retained and overhauled.

The process of manufacture adopted is as follows: The marl is excavated from the deposit in the lake, which is close to the mill and brought to the plant by tramway, the excavation being done by a dredge. The clay is found underlying the marl and is conveyed to the mill in a similar manner. After delivery to the mill, the marl and clay, mixed together in correct proportions by weight, is passed through a pugmill, from which it is discharged into concrete slurry pits. From these the mixture is pumped to tubemills and finely ground. After passing through the tubemills, the slurry is discharged into steel storage tanks fitted with agitators and pumped from them directly into the kilns. After passing through the kilns, the cement is subjected to preliminary reduction in dry pans of English manufacture,

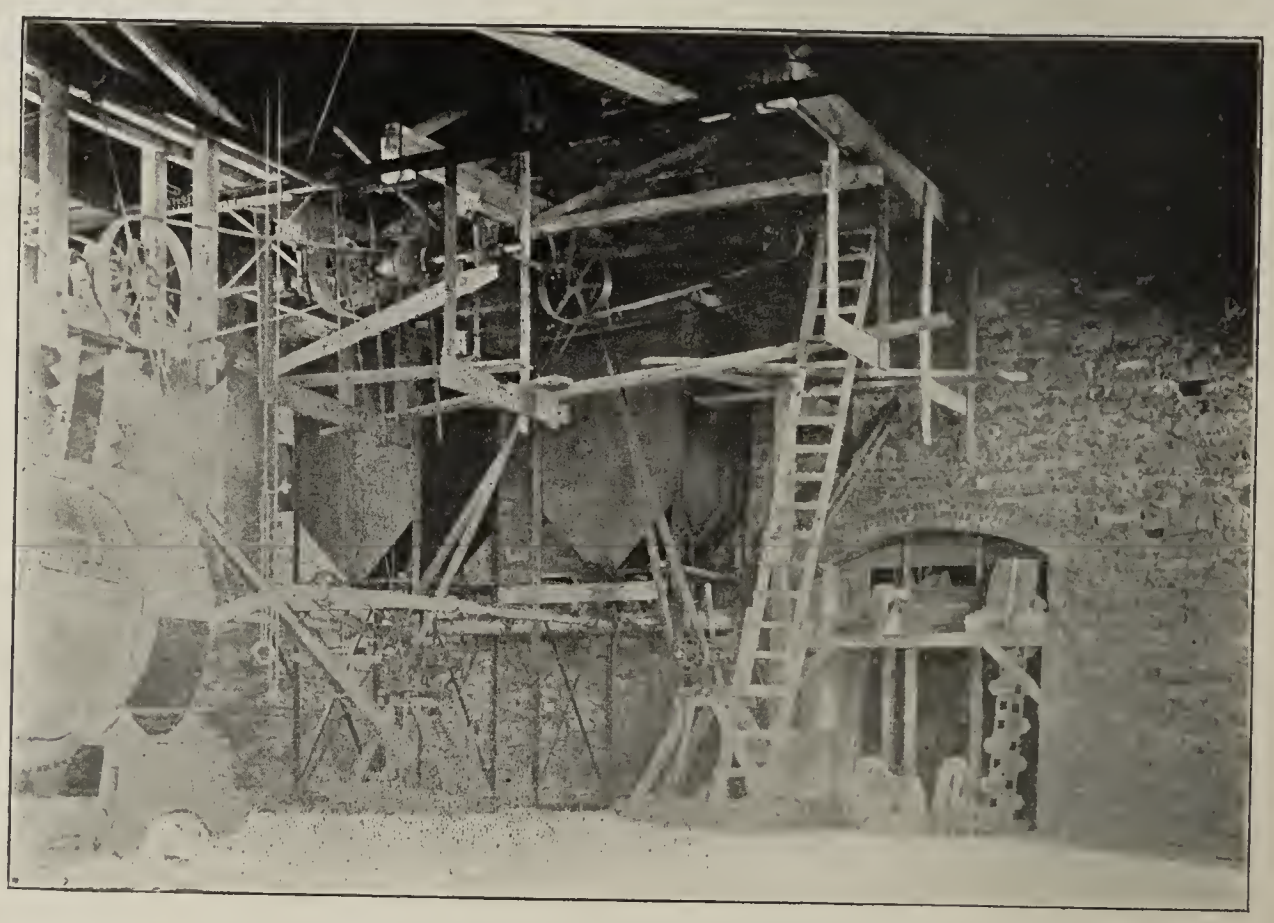

Fig. 2.—Coal bins and piping for feeding pulverized coal into rotary kilns.

which were part of the original equipment of the mill.

From the dry pans the material is elevated and screened, the tailings being returned to the dry pans for regrinding, and the finer portion taken to two tubemills. After passing through these, the finished cement is carried to the stock-house by conveyors.

The remodeled plant was started in operation in August, 1899, and the success was so great that the company decided to enlarge the plant, and during the past winter have installed three additional rotary kilns and added additional grinding machinery, engines, boilers, etc., which will give the plant a minimum production of five hundred barrels per day for the coming summer.

Photograph No. 1 shows the frame work of the fuel building and the rotary dryer being installed. The coal is brought in on a switch and stored in the pit to the left of the dryer, from where it is elevated and fed into the rotary dryer. After passing through the dryer, it is discharged into a tubemill, which, at the time the photograph was taken, had not been installed. From here the now finely pulverized coal is conveyed to the stock bins shown in photograph No. 2, which was taken during the course of erection, the scaffolding still being up; from these bins the powdered coal is blown into the kilns mixed with air.

Photograph No. 3 is a view of the kiln house after the plant was in operation. The material in the foreground on the left is the clinker from the kilns. The space occupied by the clinker was left to admit of the erection of the three additional kilns previously mentioned as now being installed. Afterwards the clinker will be stored in a special building erected for this purpose.

Photograph No. 4 shows the kiln building, with the slurry grinding building in the course of erection. This building was built of timber and covered with corrugated iron. The frame work on the outside supports an elevator for lifting the raw material to the pugmill, which was formerly located on the top floor. Since the plant has been increased, the pugmill has been placed on the ground outside, and the entire capacity of the raw material building used for storage of slurry.

Photograph No. 5 shows the general view of the plant taken from the Bay of Quinte railroad and shows in the foreground the boiler house and engine room. Behind is seen the kiln building; the clinker-grinding building and stock-house are hidden by the power house. The raw material building is shown on the right of the photograph with the two stacks of the kiln just back of it. On the extreme right is shown the stack of the old Hoffman kiln, which was torn down to make room for the new building, the brick and stone being used in their construction, and only the stack left standing. Just in front of the stack is the old bottle kiln, used when the plant was first started in operation. This kiln was lately operated to supply cement for the reconstruction of the plant.

The plant, with its production of between five and six hundred barrels per day of the highest grade of Portland cement, will be the largest in operation in Canada.

Fig. 3.—Kiln room, with clinker cooling on the floor and slurry tanks in rear.

Fig. 4.—Kiln building, and slurry grinding building, to the left under erection.

The S. Howes Co., Silver Creek, N. Y., has issued a handsome catalogue, covering a line of packing machinery especially designed for barreling and bagging cement, plaster, clay, point and pulverized minerals, sack and bag cleaning devices, mixing, sifting and blending machinery, giving sizes, dimensions, capacity and prices. Each machine is illustrated and described. The catalogue will sent on application.

THE McKELVEY CONCRETE MIXER.

Read the following letter in refer- to the McKelvey concrete mixer. It speaks for itself:

(COPY.)

THE GARDEN CITY SAND CO.,
GENERAL BUILDING SUPPLIES.
SECURITY BUILDING.
CHICAGO, ILL., May 22d, 1900.

To whom it may concern:

We have seen the McKelvey Concrete Mixer used on the work of the Northwestern Yeast Company's building, this city, and found the results as follows:

The mixing of the concrete is beyond question superior to the best hand mixing, as all the particles of stone and sand are completely enveloped by the cement and the whole evenly distributed in the mass in a manner never accomplished by hand.

Two men at the feed and two men at the crank can easily run through the machine five cubic yards per hour. A test of a single yard was made which was run through in eight minutes actual running time.

We note an advantage in the fact that no special supervision as to the mixing is required in the use of the machine; if the material is run through, the mixing can be relied upon.

As a labor and cement saver the facts above presented should convince any practical man. We unhesitatingly recommend the machine to the trade, fully satisfied that it will accomplish all and more than the inventor claims for it.

THE GARDEN CITY SAND COMPANY,
N. C. Fisher, Sec.

A cement plant for West Dallas, Texas, is under consideration.

The Peninsular Portland Cement Company has the foundation in for its plant. The cooper shop is finished.

The Colorado Portland Cement Company started making clinker on the 16th inst. Grinding will begin within a week.

The Arroyo Ditch and Water Company of Downey, Cal., has just finished a 6-mile cement flume. J. C. Sheppard was the contractor.

The American Cement Company of Philadelphia will furnish 1,500,000 rels of cement for the New York Rapid Transit subway construction.

Twenty-five thousand barrels of cement have been rejected by the United States naval authorities at Annapolis, Md., the same not being up to specifications.

Three hundred and sixty Boston physicians residing in the Back Bay district have united in a petition for paving the streets in that district with asphalt on sanitary grounds.

The Alsen Cement Company is exploring its limestone rock at Smith's Landing, N. Y. Diamond drills are being used. J. A. Brennan & Co. of Scranton, Pa., have the contract for the work.

The Samson Cement Plaster company of Dillon, Kas., has increased its capital stock from $6,000 to $75,000.

Incorporated: Warren Portland Cement Company, Jersey City, N. J., to deal in cement; capital, $400,000. Incorporators, W. Fillingham, A. G. Brown, E. B. Hawkins; J. B. Dill, attorney, New York City.

The Hemmoor Portland Cement Company at Hemmoor, near Hamburg, has purchased 2,500 shares, amounting to 1,000,000 marks, in the German-American cement works at Chicago, which will be opened shortly.

Incorporated: Hoagland & Robinson Company of Haverstraw, N. Y., to deal in brick, lime, cement; capital, $20,000. Directors, Henry C. Robinson, Henry P. Robinson, Arthur J. H. Brooks of New York City.

The Barber Asphalt Company was awarded a judgment for $1,200 against the Louisville Gas company for damages to the asphalt pavement on Walnut street, Louisville, caused by escaping gas from the street mains.

The gross business of the American Cement Company for the four months ended March 31 shows an increase of 18 per cent over the corresponding period of last year. The balance sheet showed a surplus of quick assets over current liabilities of $243,000.

The capital stock of the Glens Falls Portland Cement Company of Glens Falls, N. Y., has been increased from $400,000 to $500,000, consisting of $100,000 of preferred stock and $400,000 of common stock. The amount of capital stock paid in is $370,000, and the company's debts and liabilities are placed at $76,000.

FIG. 5.—Beaver Portland Cement Co.'s plant, Milbank, Ont. Bay of Quinte railroad tracks on the left.

The Coplay Cement Company has sold its four mills and 300 acres of land at Coplay, Pa., for approximately $1,500,000, to G. Blum of Philadelphia, and J. F. Plaistor of London, representing a syndicate of Philadelphia and London capitalists.

Monolith, a plaster floor covering, has been adopted by the Pullman Car Company for its cars. The material is composed of pulverized sawdust and a liquid cement. The Northwestern Expanded Metal Company of Chicago manufacture the composition.

The Osborn Co., Osborn building, Cleveland, O., have been selected as the consulting engineers for the Manitoba Union Mining Co. The Osborn Co. will prepare the plans and specifications for the new cement plant for the Manitoba Union Mining Co. This plant will be located near Winnipeg, Manitoba.

The Lehigh Portland Cement Company's new mill, designated B plant, located at West Coplay, Pa., will start up in June with a capacity of 2,000 barrels per day. This, with mill A plant, will give the company an output of 3,600 barrels per day. The company is considering the erection of another mill in the near future of sufficient capacity to bring the company's output up to 6,000 barrels per day.

The industrial department of the Pere Marquette Railway at Grand Rapids, Mich., is circulating a pamphlet describing the industrial resources of Michigan adjacent to the line of its right of way. Its holdings include extensive beds of marl suitable for the manufacture of Portland cement. Three analysis of this material are given showing as high as 90 per cent carbonate of lime. Reliable information is tendered to parties interested by addressing as above.

GERMANY.

EXPORT OF CEMENT IN TONS.

TO	MARCH.		JAN.-MARCH.	
	1899	1900	1899	1900
Freeport, Hamburg	225	2,240	1,355	3.188
Belgium	186	271	1,089	1,197
Denmark	1,241	909	1,351	1,028
Great Britain	68	833	269	995
Holland	3,368	4,590	8,581	9,369
Norway	937	1,653	2,303	2,495
Austria	1,347	1,224	3,383	2,488
Russia	229	133	331	251
Finland	.....	2	19	255
Switzerland	1,348	669	2,373	1,415
Cape	662	714	1.700	1,241
Transvaal	612	.....	2,178	170
China	2,319	1,963	6,960	3,135
Dutch East Indies	1,071	523	2,992	2,874
Argentine	65	1,419	4,615	4,959
Brazil	1,236	1,683	3,560	4,868
British North America	323	.....	323	253
Chili	776	728	1,808	1,431
United States	20,625	28,863	39,404	64,280
Australasia	2,615	4,341	7,623	8,872
Totals, with others	41,002	57,029	98,119	123,687
1898	40,996	.....	95,016	.....
1897	48,718	.....	78,032	.....

BELGIUM.

EXPORT OF CEMENT IN TONS.

TO	MAR.	JAN.-MARCH.		
	1900	1900	1899	1898
Germany	282	1,062	674	1,215
Great Britain	5,185	13,267	17,195	6,870
Australasia	11	103	3,571	1,253
Brazil	1,548	7,866	1,609	4,232
Canada	76	76	207	191
Cape Colony	846	878	692	669
Chili	108	147	229	577
China	785	1,208	995	2,668
Cuba and Porto Rica	1,656	1,675	1,363	37
Egypt	1,392	3,570	2,520	1,212
Spain	879	1,440	1,226	1,172
Congo Free State	23	341	316	125
United States	11,148	21,095	12,225	24,891
France	1,058	2,773	2,237	1,651
British East Indies	388	1,253	1.915	1,968
Japan	4	12	366	2,845
Mexico	1,603	1,805	1,650	261
Natal	.....	.....	1,401	413
Norway	427	1,395	1,180	646
Holland	4,070	8,993	7,304	8,315
Portugal	701	1,461	844	704
Argentine	4,469	8,092	8,075	8,658
Roumania	19	19	147	177
Russia	.....	1	74	306
Turkey	.....	42	117	33
Uruguay	21	61	64	72
All others	1,607	3,405	3,192	1,786
Total (kils.)	.....	82,082	71,400	72,959
March only	38,318	.....	29,568	33,278
Full years	.....	.....	449,936	419,131

ENGLAND.

CEMENT SHIPPED FROM PORT OF LONDON.

March, 1900.

TO	TONS	TO	TONS
Alexandria	4,364	Malta	75
Amsterdam	115	Maryboro	2
Auckland	187	Mauritius	17
Azores	81	Melbourne	1,030
Bahia	17	Montevideo	320
Buenos Ayres	1,352	Napier	92
Bermuda	48	Newcastle, N. S. W.	178
Baltimore	89	New Orleans	306
Boca	114	Newport News	185
Bombay	651	New York	166
Boston	90	Odessa	30
Brisbane	93	Paramaribo	50
Calcutta	844	Penang	45
Canarles	18	Puget Sound	498
Cape Colony	1,469	Rangoon	271
Channel Isles	271	Rotterdam	167
Coatzacosalas	541	San Francisco	4,965
Colombo	461	San Juan	18
Constantinople	9	Santos	804
Demerara	441	Shanghai	33
Kunachee	54	Singapore	634
Labnan	53	St. Croix	26
La Plata	33	St. John, N. B	17
Lyttieton	330	St. Lucia	72
Durban	611	Surinam	30
Galatz	20	Sydney	257
Gibraltar	1,962	Trinidad	827
Halifax	60	Truro	50
Hamburg	9	Vancouver	545
Harlingen	54	Vera Cruz	125
Havana	222	Victoria, B. C	167
Honolulu	1,236	Wellington	95
Jamaica	179	Yarmouth, N. S.	34
Madras	54	Yokohama	36

UNITED KINGDOM.

EXPORT OF CEMENT IN TONS.

TO	APRIL.		JAN.-APRIL.	
	1899	1900	1899	1900
Holland	240	406	1,197	1,379
United States	3,668	7,075	5,581	19,503
Brazil	309	1,408	4,498	4,287
Argentine Republic	1,336	1,578	5,843	5,749
British South Africa	971	3,603	11,984	11,838
British East Indies	4,499	2,273	17,132	16,565
Australasia	1,446	3,000	10,297	9,222
Canada	1,792	1,611	2,158	3,488
All others	9,125	14,140	42,395	51,613
Totals	23,386	35,094	101,085	123,644

Exports of cement for April, 1898, were 29,873 tons; from January to April, 1898, 114,339 tons.

CEMENT IMPORTED INTO THE UNITED KINGDOM.

From December 1, 1899 to February 27, 1900.

FROM	TO	TONS.	£
Antwerp	Liverpool	140	300
"	"	32	70
"	"	100	158
"	Bristol	14	23
"	"	11	20
"	"	178	103
"	Cardiff	202	302
"	"	49	74
"	Goole	115	220
"	"	60	114
"	"	49	93
"	Grimsby	10	100
"	Manchester	50	75
"	"	10	15
"	Middlesboro	100	200
"	Newcastle	13	26
"	Preston	215	322
"	Southampton	44	66
"	Sunderland	336	671
"	Douglas	133	200
"	Glasgow	170	499
"	"	435	1,306
"	"	327	981
"	"	255	766
"	Grangemouth	236	420
"	"	256	475
"	Belfast	130	195
"	Dublin	30	60
"	"	50	73
"	Ramsey	88	101
Brussels	London	50	70
"	"	86	130
"	"	67	101
Boulogne	Cardiff	51	76
Copenhagen	London	5	10
Ghent	"	50	90
"	Liverpool	95	210
"	Goole	10	19
"	"	10	19
"	Hull	80	405
"	"	219	870
"	"	86	340
"	"	110	330
"	Manchester	177	244
"	"	51	75
"	"	59	89
"	Newcastle	53	105
"	Sunderland	250	500
"	Ayr	732	1,038
"	Leith	100	125
"	"	150	187
Hamburg	Dundee	100	325
Nieuport	Ramsgate	90	135
Rouen	London	90	270
Rotterdam	Aberdeen	300	600
Stettin	Manchester	50	69
Temeuzen	Teignmouth	125	239

UNITED KINGDOM.

EXPORT OF CEMENT IN TONS, APRIL, 1900.

TO	TONS	TO	TONS
Albany	1,296	Larnaca	10
Alexandria	4,154	Lisbon	179
Amsterdam	512	Lyttleton	330
Auckland	134	Madras	45
Buenos Ayres	1,578	Malta	146
Bahia	184	Mauritius	83
Barbadoes	146	Melbourne	259
Bermudas	27	Montreal	298
Bluff Harbour	27	Nagaski	248
Bombay	418	Napier	45
Boston	13	Nelson	98
Brisbane	178	Newcastle, N. S. W.	178
Baltimore	54	New Orleans	89
Calcutta	517	Newport News	501
Canada	35	New York	171
Capetown	1,204	Odessa	32
Channel Isles	302	Otago	54
Chinde	6	Penang	38
Cologne	7	Port Elizabeth	1,580
Colombo	549	Rangoon	623
Constantinople	36	Rockhampton	54
Demerara	411	Rotterdam	224
Durban	464	Rouen	50
East London	173	San Francisco	2,841
Galatz	20	San Diego	3,576
Gibraltar	2,500	Santos	268
Gothenburg	4	St. John, N. B.	33
Halifax	218	St. John, N. F	154
Hamburg	210	St. Lucia	18
Harlingen	27	Sydney	833
Havana	689	Trinidad	439
Hobart	87	Vancouver Isle	84
Hongkong	5	Vera Cruz	331
Jamaica	347	Vladivostock	379
Kunachee	44	Wellington	143
La Guayra	15		

IMPORT OF CEMENT INTO UNITED KINGDOM, 1900.

MONTHS.	TONS.	VALUE £
January	3,934	8,682
February	7,018	14,857
March	5,401	12,213
April	7 918	17,694

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

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IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	MARCH.				NINE MONTHS ENDING MARCH.			
	1899.		1900.		1899.		1900	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom	9,388,551	37,327	1,251,227	4,476	96,289,730	347,638	62,653,204	247,512
Belgium	15,250.074	40,212	26,230,961	79,234	206,644,288	619,322	208,055,646	622,166
France	297,600	1,199	374,000	1,674	5,418,800	16,829	4,397,345	16,595
Germany	29,911,146	102,669	36,052,244	135,939	309,287,934	1,057,932	355,530,762	1,272,742
All Other Europe	396,800	1,474	1,511,894	5,191	11,108,052	34,881	18,807,612	61,499
British North Am.	.....	.....	.....	.....	1,043,120	4,729	897,790	5,111
Other Countries	.....	.....	842,300	3,790	2,000	9	3,441,160	16,452
TOTAL	55,244,171	182,881	66,262,626	230,394	629,793,924	2,080,940	653,783,609	2,242,077
Domestic Exports of Cements, bbls.	16,461	32,903	6,390	15,738	40,247	83,845	54,252	114,090

There were 4,742,116 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on March 31, 1899, valued at $14,507, against 6,798,906 lbs., valued at $21,194 in March, 1900.

Imports of asphaltum or bitumen for March, 1899, were 3,810 tons valued at $17,404; March, 1900—11,153 tons valued at $40,361. For nine months ending March, 1899, 42,284 tons valued at $135,074; for nine months ending March, 1900—79,687 tons valued at $249,571.

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7 Bonnot Morris Mills; Clinker Grinders	$500
2 Bonnot Separators or Screens, capacity of each 40 Barrels per hour	150
3 Hassen patent; wet mixers and grinding; disc mills	75
2 (1 pair) Marsh Air Compressors, 14x18x20, with Reservoir	500
2 Tubular Boilers, with Stack; Flues 36—4 inches; 16 feet full front	500
1 Upright 6 horse-power	100
1 Stilwell & Bierce Closed Heater, No. F, 45 inches diameter, 9 feet long	200
2 10 inch Gate Valves	25
2 Steel Tanks, with Cover; 8 feet high, 36 feet diameter	400

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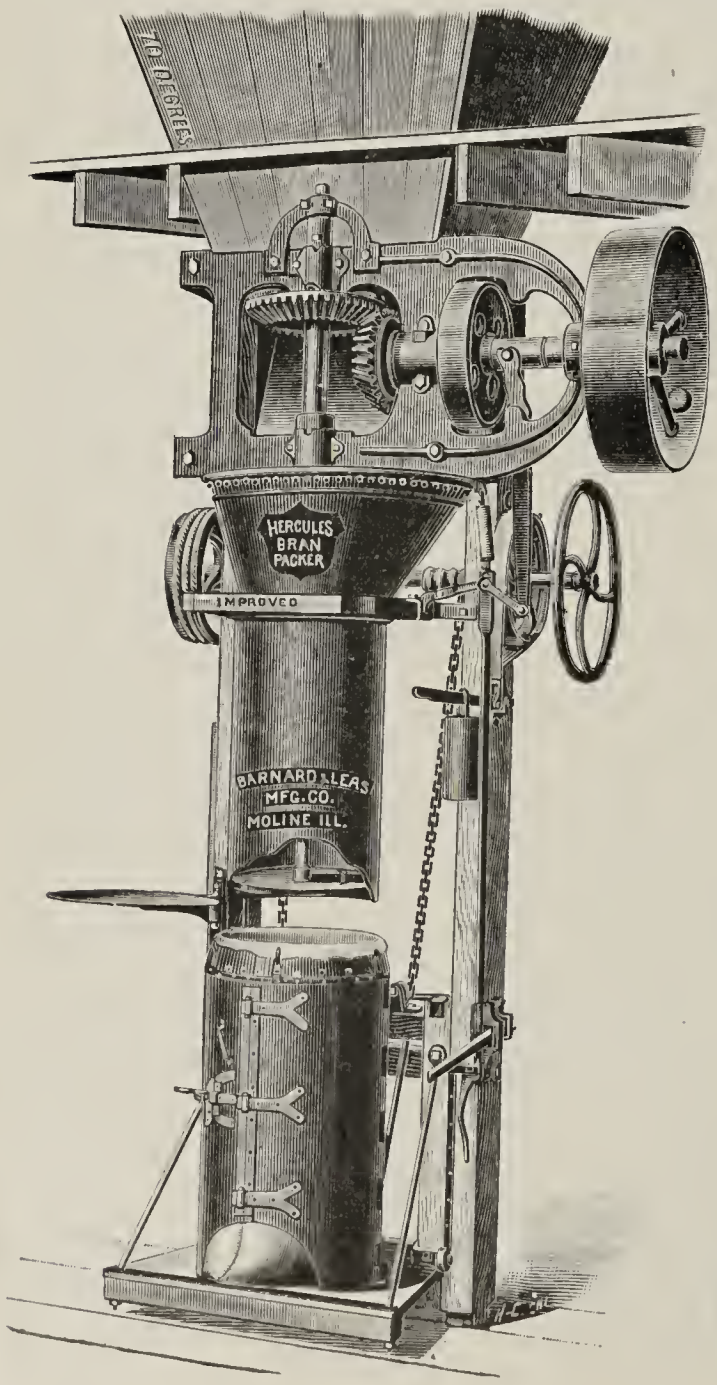

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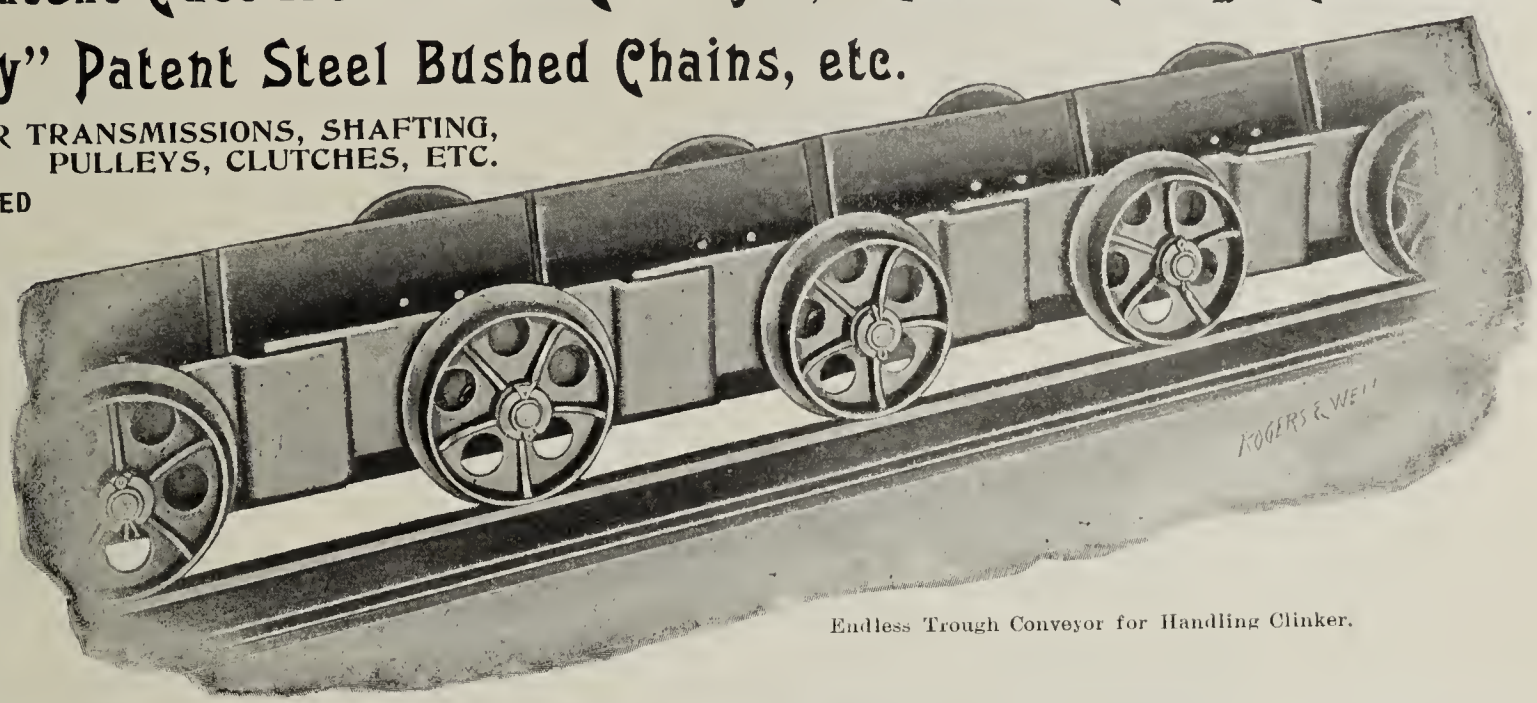

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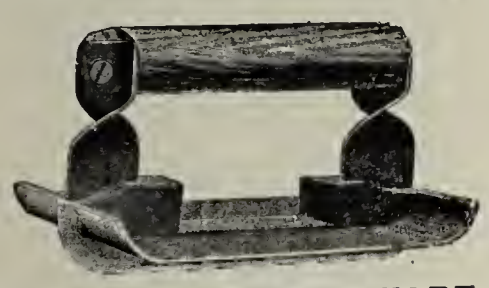

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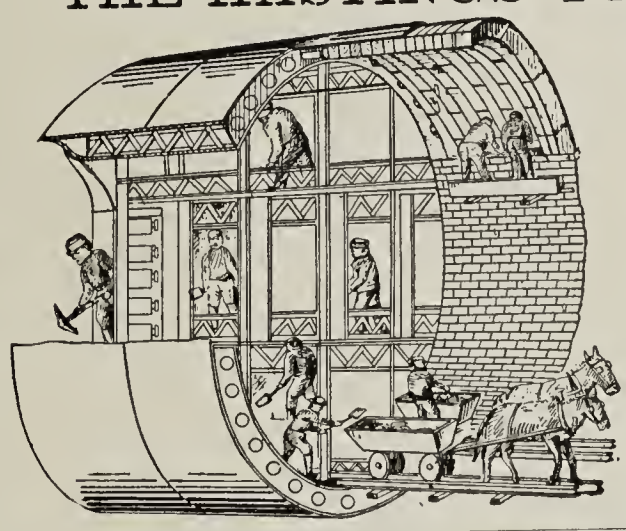

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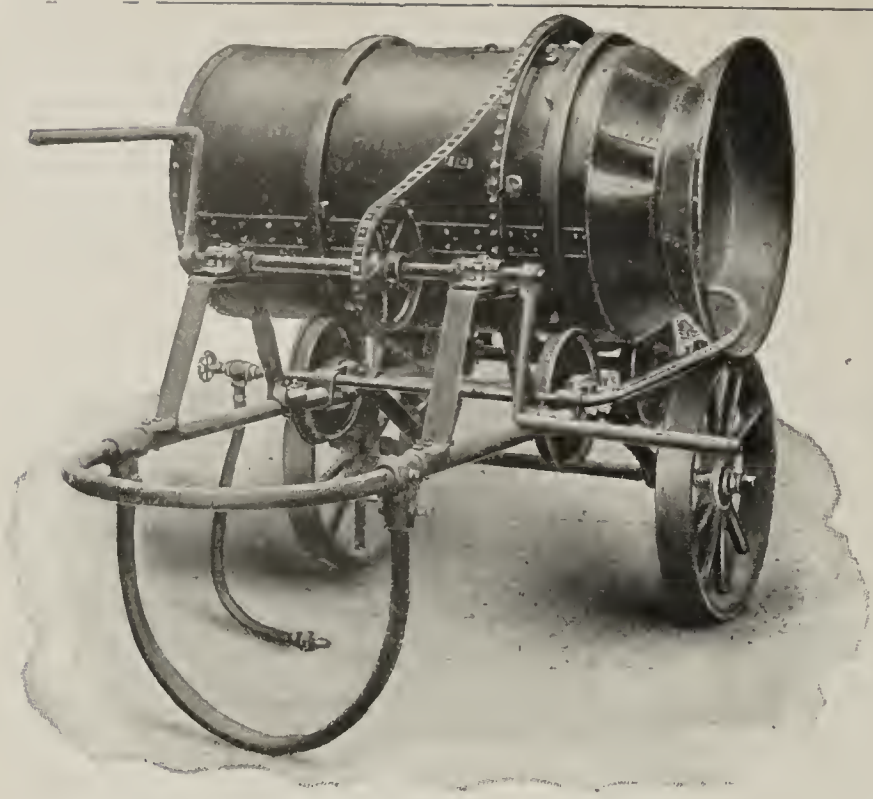

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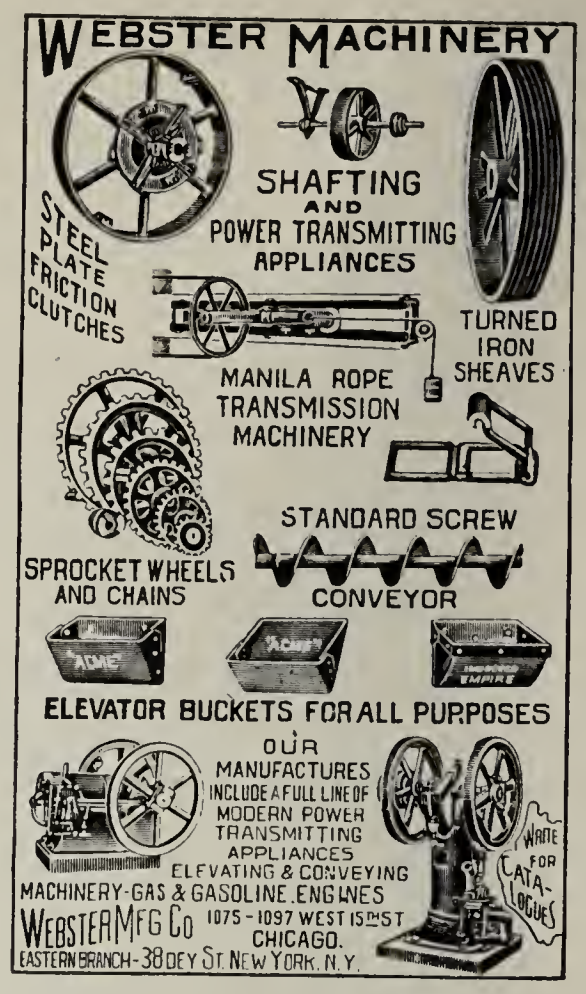

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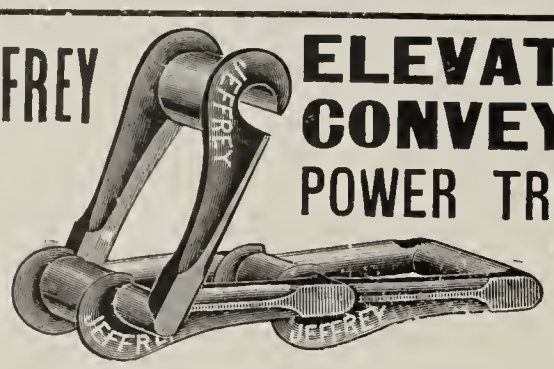

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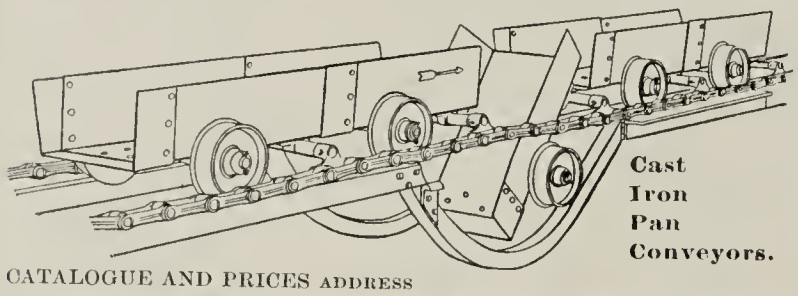

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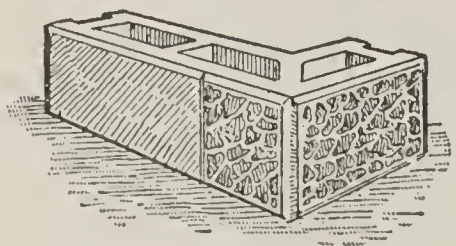

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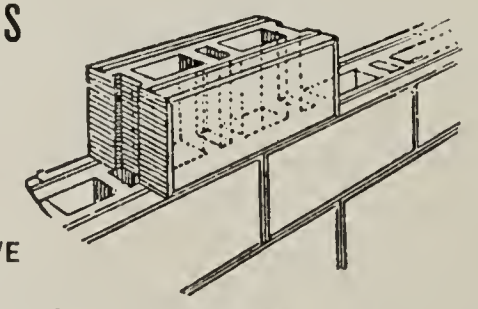

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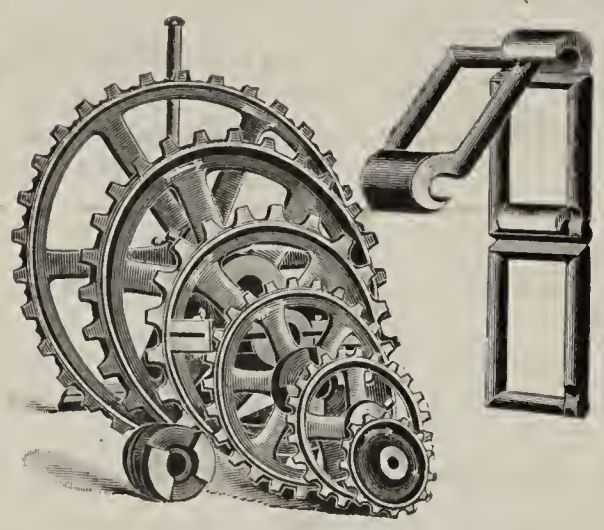

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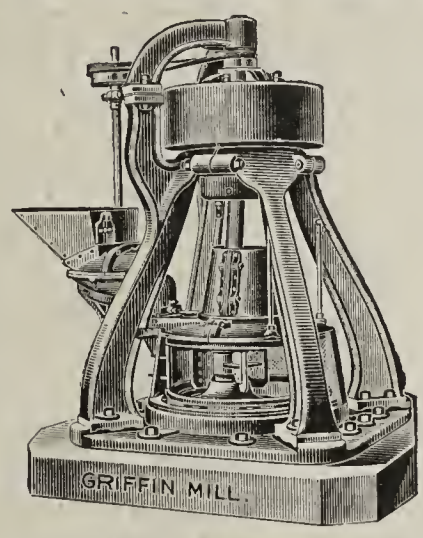

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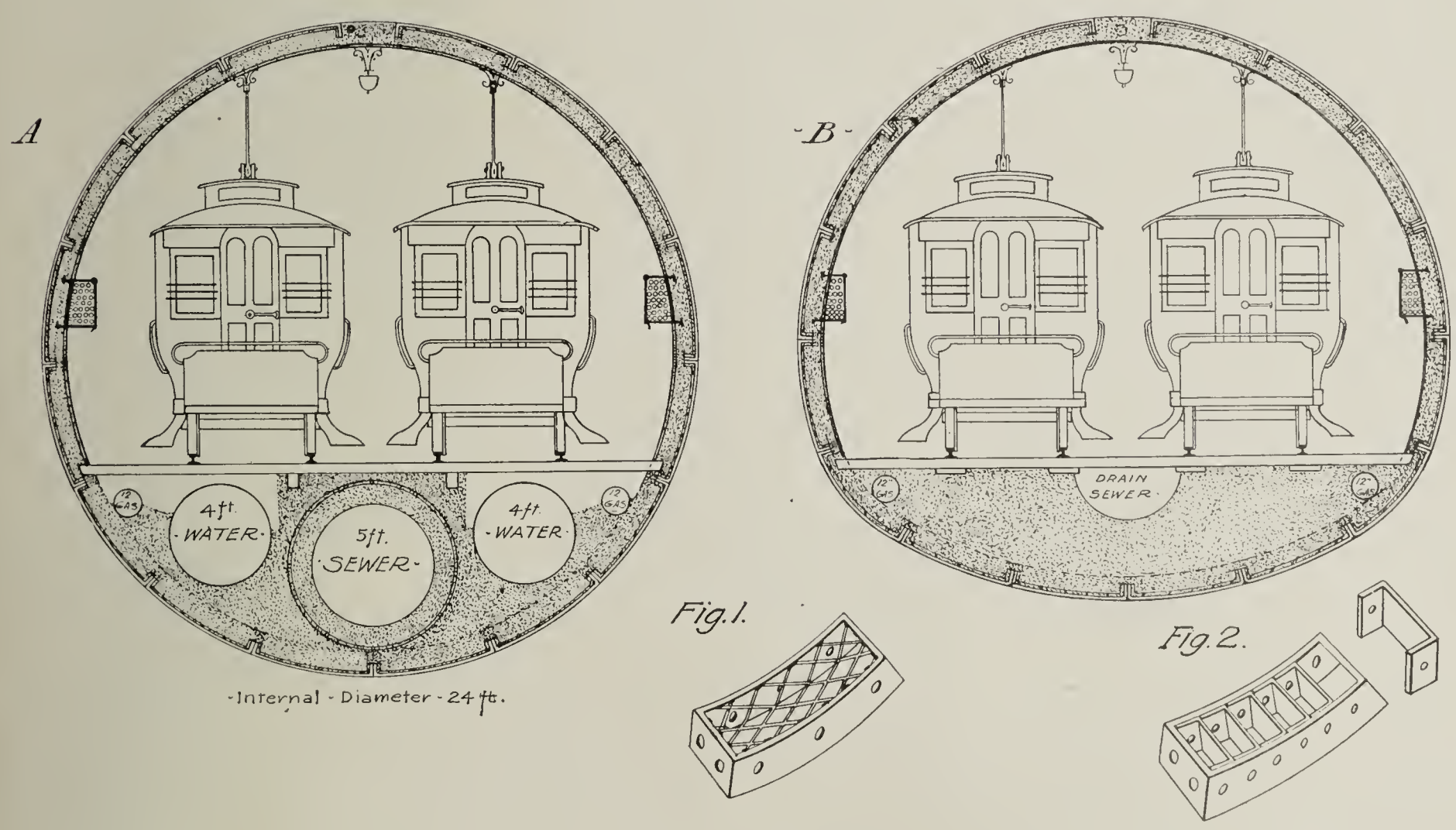

Cross Section of Proposed Chicago Loop Subway showing concrete masonry with outer iron lining and inner finish of expanded metal and cement mortar. Figs. 1 and 2 show the cast iron and steel segments, respectively, of which the outer lining is constructed. Plans and description by Cornelius G. Hastings, 1401 Monadnock Bldg., Chicago. (See description on another page.)

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(PUBLISHED MONTHLY)

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The present issue of the CEMENT AND ENGINEERING NEWS contains a complete index from July, 1896, to Dec. 31, 1899.

THE WORLD'S COAL INDUSTRY.

The United States is the only coal producing country in the world having an output in excess of the demand. We are now shipping coal to France, Germany, Russia, Italy, Sweden and England, where shortages exist. The world's output for 1899 was 7,751,000,000 tons, of which the United States produced 230,083,980 tons, while the highest output of the United Kingdom was 202,942,000. Germany comes next with an output of 131,000,000 tons; Austria, 35,858,000 tons; France producing 32,439,786 tons; Russia, 11,207,475 tons. The declared exports from the United States for 1899 were 1,571,581 tons anthracite and 3,480,452 tons bituminous. The United Kingdom exported 41,180,300 tons in 1899, France, Germany and Italy being the largest purchasers. The declared value of the English coal exported for 1899 was $110,807,306. The average price at the pit's mouth in 1898 for the entire Kingdom being $1.38 per ton net.

This price is higher than obtained for bituminous coal in the United States where higher wages are paid. The increased output in the United States is due to labor saving machinery used, which Europe is slow to adopt. The coal areas of Great Britain cover 9,000 square miles, against 194,000 square miles in the United States. The United States has 48,447 coke ovens in operation and 1,048 buildings from which 16,047,209 tons of coke were produced in 1899, from 25,249,570 tons of coal; the coke being valued at $25,586,699 at the ovens. The serious interference in the manufacturing industries and transportation facilities of Europe during the past two years, due to the scarcity of coal, clearly demonstrates that the United States is destined to fulfill its mission as the leading manufacturing nation of the world, as indicated by the trend of passing events.

MINING COAL UNDER THE SEA.

The great zinc works at Arnao, Spain, obtains 50,000 tons of coal a year from a coal mine, which extends under the Bay of Biscay. On the sea side of the shaft, working has to be carried on with the utmost precaution and very slowly. The watertightness of the submarine portion of the mine is due, not only to the slowness with which the working is carried on, but also to the existence of certain beds of shale which crack and fissure when pressure comes on to the roof, and then swell as the sea water filters through.

Unlike most of the Asturias coal, which is friable, dull and iridescent, the Arnao coal, especially that from the portion of the mine below the sea, is hard, brilliant and whitish, like that from the Saar coal field, this whitish tint being due to scales of calcium sulphate, and sometimes there is an appearance of concentric rings on the surface of the coal pieces.—*Black Diamond.*

The German Portland cement manufacturers have issued a call for a meeting for the purpose of establishing a Central Bureau through which the entire output of the German cement mills is to be sold.

Thirty thousand barrels of Portland cement have been purchased for the construction of a concrete grain elevator at Duluth by the Peavey Duluth Terminal Co., 10,000 piles have been driven for the superstructure.

Graphite has been discovered near Raleigh, N. C.

Louisville, Ky., has contracted for brick pavement at $1.12 per yard.

The Empire Portland Cement Co. is using a greater percentage of wooden packages than heretofore.

The Remer lime and cement warehouse at Saginaw, Mich., was destroyed by fire June 22, loss $4,500, insurance $10,000.

The American Cement company's gross earnings for six months ending June 1, show 35 per cent over the same period of last year.

The Edison Portland Cement company has nearly 300 men and two steam shovels at work on its new plant at Stewartsville, N. J.

The Baker Bros. stone crushing plant at Kearneysville, W. Va., was destroyed by fire June 5. The plant furnished the B. & O. Ry. 60 cars of ballast daily.

The C. A. Brockett Cement company's warehouse, Kansas City, Mo., was destroyed by fire. The Keystone foundry has been leased by the company for a new warehouse.

Three Rivers capitalists have organized a Portland cement company, a tract of marl land three miles west of Three Rivers, Mich., has been purchased where the plant is to be erected.

The corner stone of the Newaygo Portland Cement company's plant will be laid June 28. A balloon ascension, fire works and a ball at the Newaygo opera house will celebrate the event.

A bill introduced during the closing hours of congress by Mr. Ridgely asks for an extension of the patents granted to Benjamin F. Holland of Utica, Ill., for improvements in grinding cement.

The White Cliff Cement & Chalk Co., now in the hands of a receiver, is to be turned over to the Dutch bondholders. The Kelley interests do not entirely favor such a disposition of the plant.

The Green River Asphalt Co. has contracted to lay asphalt pavements at Louisville, Ky., at $1.49 and $1.69 per square yard, while the Louisville Park Board is paying $1.55 for asphalt boulevard pavements.

Portland cement pavements are being laid in Berlin, Germany. Crushed stone and sand being used, substantially the same as foundations for asphalt pavements the surface finish being left comparatively rough without troweling, two weeks after the work is in, the street may be opened for traffic.

A FEW OBSERVATIONS ON A VISIT TO AMERICAN CEMENT WORKS.

By Dr. W. Michaelis, Jr.

Having introductions to a great number of American cement works and testing laboratories I have become acquainted with the methods of working in this country, and being familiar with the different methods of manufacture in Germany, Belgium and England, I have had occasion to observe the difficulties which these countries have to deal with, and on account of the higher priced labor in England and America the gradual necessity of avoiding a surplus of manual labor as far as possible and of adopting an almost automatic system.

The progress which America has made in the last few years with the rotary kiln is astonishing and, as the American practice in engineering is so far advanced to-day, the present difficulties in technical management will gradually be overcome. But another difficulty may continue for some time. I refer to the lack of cement chemists possessing the necessary experience in developing the process from a scientific point of view, and who must have a thorough knowledge of the properties of cement and be equipped with the proper apparatus for their laboratory work.

To begin with the mill itself, there are improvements to be observed in every new plant erected. At the Nazareth works, Lehigh Valley, the raw materials are still weighed off and mixed in proper proportions before having been crushed, dried and ground, whereas at one of the newest plants in the Lehigh Valley, at the Coplay cement works, the endeavor to survey the chemical control as carefully as possible has gone so far, as to perfectly separate the crushing, drying and grinding of the two raw materials, cement rock and limestone, and in this way to enable the chemist to make analyses of a real average sample and to avoid faults which may happen by an unawaited change in the composition of the raw materials.

In the western cement manufacturing district, where the raw materials are, with a few exceptions, marl and clay and where the wet process is applied, the chief improvement of the future will have to consist in bringing down the content of water in the slurry, and in this way to save a great percentage of fuel. The slurry after leaving the mills and before entering the kiln is generally run into large storage-tanks, where it is stirred by harrows in order to prevent separation by gravity. This slurry contains 50 per cent water, which must be evaporated in the upper part of the rotary kiln. Why is this content of water carried so high? The treatment of the raw materials by edge-runners and tube mills does not make it a necessity to add 50 per cent water instead of the 40 per cent which is generally found sufficient in European works. It is strange to find that the single reason for this greater addition of water is only the lack of a pump which is strong enough to raise the slurry into the storage-tanks. A comparatively light double-pump is all that can be found in this country for this purpose. There is no firm which manufactures a strong triplex-pump such as those of the Mannheimer Eisengiesserei, formerly Jos. Pallenberg, Mannheim, Germany, which easily pump a slurry with 40 per cent water up to a height of 30 feet. Besides saving a corresponding great amount of fuel the ground marl and clay cannot be so easily separated by gravity.

Another observation which I made at a recently built works shows plainly the lack of scientific forethought. At this works the coal, which is fed into the kiln in a powdered state, is not dried before being pulverized. This is simply wasting energy, as the content of moisture of the powdered coal has not only to be evaporated like that of the slurry in the upper part of the kiln. The water absorbed by the coal must be decomposed at the high temperature of the flame into hydrogen and oxygen and this means an extremely great loss of chemical energy (68,000 heat units). As the moisture not only amounts to a very low percentage, but to an extraordinarily high one in this case, perhaps on account of being stored on a wet ground at a marshy place, there is no wonder, that this factory uses 75 per cent fuel for burning cement instead of 50 per cent required by other works with the same kind and the same quality of raw materials and quite the same installation of the plant.

To the want of experienced cement chemists must be added the lack of trustworthy laboratory appliances. At most of the laboratories the content of carbonic acid in the raw mixture is still titrated by standardized acid. Where a volumetric apparatus is used, which enables the operator to read off at once the percentage of carbonic acid, the Scheibler apparatus is to be found, which has reached this country perhaps via England. This Scheibler apparatus possesses faults not to be found in the Dittrich apparatus, the last which I cannot too highly recommend. The Scheibler apparatus operates without cooling the gas generating bottle and this must be often the cause of great trouble in the Lehigh Valley belt, where the cement rock contains sometimes much carbonate of magnesia, which is especially liable to develop heat and which retards the reading of the developed volume of gas. Besides there is no correction table in the Scheibler apparatus which takes into account the varying volume of carbonic acid absorbed by the hydrochloric acid, all of which the Dittrich apparatus* fully covers.

In regard to testing the tensile strength of briquettes the American apparatus is very rough and crude, for example the Fairbank's Cement Tester lacks both in construction and in finish. It should be replaced by the German Standard Apparatus* for testing tensile strength, which has replaced the old style apparatus in England, where people are very conservative, and is universally used throughout the continent.

The chief reason why the knowledge of chemists about the properties and testing cement mortars do not keep pace in this country with the rapid technical development in the cement industry is in my mind the lack of a suitable literature. They are confined to the poor English literature on that subject and only those who can read French and German have admittance to the famous book of E. Candlot, Ciments et Chaux Hydrauliques, which is written from the highest scientific standpoint, and to the more practical book of Dr. C. Schoch, Moderne Aufbereitung und Wertung der Moertel-Materialien, which embraces all the processes and the various kinds of machinery ever used in cement chemistry.

Of course all kilns and machinery used in European countries are not of sufficient interest for Americans, who are principally interested in the rotary kiln, but the Continental literature will enable them to obtain a more thorough knowledge of cement chemistry both in practical and theoretical experience.

* I shall endeavor to describe the apparatus above mentioned in a future issue accompanied by engravings.

We have on exhibition in our sanctum samples of gypsum taken from the Gypsum Mines' plaster beds near Cayuga, Ontario, Canada. It is the finest article we have ever seen.

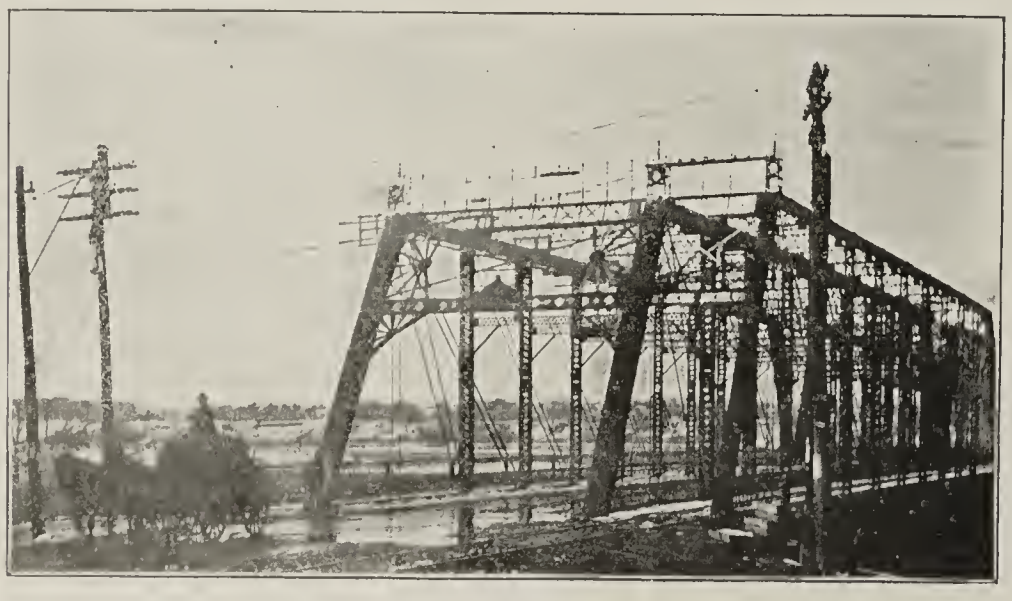
A cement track wagon road is proposed between Sacramento and Stockton, Cal. Two 24-inch concrete tracks laid and spaced on standard vehicle gauge and one foot deep on which the wheels of the vehicles are to travel, the greater loads and higher speed resulting from this system of public highways are points in favor of its construction.

CONCRETE VERSUS STEEL FOR BRIDGES.

By Daniel B. Luten.
Instructor in Civil Engineering, Purdue University.

The increase in the quality of American Portland cements, together with decreased cost, and the better understanding of the nature of concrete, which the past few years have developed, has brought about an age of popularity for concrete construction that is to some extent comparable with the suddenly increased use of iron and steel of a few years ago. A comparison of the two materials in their application to bridge structures may enable us to predict with considerable certainty what the growth of concrete construction is to be.

Steel is a material which at the present time has been well investigated as to its qualities of strength, elasticity, etc. Concrete is a more variable material; the conditions necessary to the production of good concrete are not so well understood as in the case of steel. The process of manufacture of steel involves such difficulties that experts are required from one end of the process to the other. Concrete is usually made by men more or less unskilled in its production, and as a consequence, much concrete work has resulted that has not proved entirely satisfactory. With proper selection of materials by testing, and with skillful superintending and handling, concrete can be produced that will permit the use of a factor of safety of six, as compared with an allowable factor of safety of four for steel subjected to similar conditions of loading. The use of allowable unit stresses based on this assumption will produce a structure that can be trusted to bear with perfect safety the loads for which it is designed.



But concrete possesses a decided advantage over steel in that it grows continually stronger with increasing age, while steel grows constantly weaker. Experiments have shown conclusively, that for the first five or six days, concrete increases very rapidly in strength; then the increase becomes less marked, but is nevertheless sufficient to double in strength in a few years.

The present practice in highway bridge construction is to design steel bridges for loads of from 100 to 150 pounds per square foot, which includes a very large allowance, sometimes as great as fifty per cent for the probable growth and increase in weight of traffic. This the concrete bridge provides for abundantly in the natural increase in strength of the material, which multiplies more rapidly than traffic possibly can.

Steel moreover deteriorates, due to the action of water causing rust. Such deterioration may to some extent be prevented by proper painting; but proper painting implies something very different from the methods in common use for highway bridges. Rust, once it has commenced, is not eradicated by covering with paint; it must first be removed by scraping or by the sand blast or by treatment with acids. And the question of selecting a proper grade of paint and of properly applying it requires much more expert skill and investigation than those in charge of such structures usually appreciate. It may in fact be stated that all steel highway bridges, on account of the serious difficulty of protecting against rust, are being steadily weakened by the action of the weather. Thus the increase of traffic and the decrease of strength are two factors that tend constantly to approach each other, and which when they meet must cause the collapse of the structure. Experiment has shown that unpainted steel subjected to average weather conditions, is destroyed by rust to a depth of about one-eighth of an inch in a century. This means that a steel highway bridge of one hundred feet span would under such conditions be decreased in efficiency from five to twenty per cent in ten years; and shorter spans would show still greater loss. With proper care and attention this depreciation would be lessened. But on the other hand local conditions may increase it materially. For example the steel bridge of Fig. 2 has a mudhole at either approach, from which water is splashed against the end posts. The bridge is about fifteen years old, and has received as good care as is usually given to steel highway structures. Yet the steel at the base of the end-ports has been destroyed to a depth of one-sixteenth of an inch, see Fig. 3.

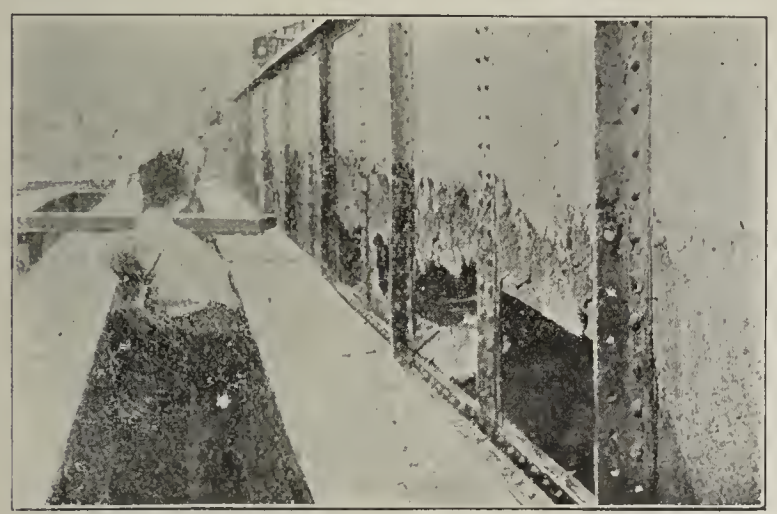
In Boston, Mass., a steel girder on Washington street, subjected to the steam and smoke of locomotives passing beneath, was removed after twenty-five years of service, in the condition shown in Fig. 4. The web plate was one-quarter of an inch in thickness. Instances of this sort in which the structure has been endangered, are by no means rare.

Steel bridges may also deteriorate due to the crystallization of the ma-

terial when subjected to frequent vibrations. The cause of crystallization and its effect are not very well understood; and when both crystallization and rust are taken into account, the security of steel for bridge structures becomes more questionable. Steel bridges must be well cared for, and must have a considerable fund provided for maintenance. That the above propositions are true is evidenced by the large number of failures of steel highway bridges reported annually by the engineering journals. A record kept by the writer from November 11, 1899, to March 10, 1900, and based on the reports of three journals, showed fourteen failures, with losses ranging from $600 to $95,000 each.

The mode of failure of bridge structures is also an important comparison. A steel truss bridge gives way suddenly by the rupture of one of its members, and necessarily carries with it the imposed load of freight and passengers; this can hardly occur with the arch of concrete, provided the abutments are properly secure. An excessive load may cause the concrete arch to crack at the crown, if not designed to meet the excessive conditions, but that by no means implies failure, any more than the presence of joints in a stone arch implies failure. The crack in fact serves as a safety valve, to give warning of excessive loading, and the arch may be repaired, or re-enforced at leisure. It must be understood however that this statement applies only when the abutments are thoroughly secured from spreading.

In considering bridge maintenance, the floor system becomes a most important factor. The usual flooring for steel bridges is of oak planks which wears rapidly, and requires frequent renewal, usually at intervals of five or six years. It is difficult also to give to such a floor, a satisfactory crown, and after some wear, the water will stand in pools on the bridge floor. Such an instance is Fig. 5, which is another view of the bridge of Fig. 2, and was taken twenty-four hours after rain had ceased. On a concrete arch, the roadway of earth, gravel or pavement, is continued directly across the bridge and the floor system is thus a part of the rest of the road and requires no more attention than is given to the usual road surface. Surface water is disposed of by tile drains through the side walls. There is therefore no trouble or annoyance on account of timber floor systems, and no difficulty about disposing of the water. No painting is necessary on any part of a concrete arch. In short, practically no maintenance of any kind is required; the concrete arch is a permanent improvement. And it may be expected to endure for an indefinite period without further attention. Nothing perhaps can show this fact more forcibly than some of the arch structures built by the Romans eighteen hundred years ago. The portions of these buildings made of concrete are still well preserved, while stone in the same structures has crumbled away. And this too in spite of the fact that the Romans used a natural cement which was but an imperfect approach to the Portland cements of to-day.



The steel truss has the sole advantage at the present time of cheapness in first cost; but with the improved methods which are being developed in concrete construction, this advantage is being rapidly decreased. And when maintenance, safety and durability are taken into account, the concrete arch may have a decided advantage in final economy.

The concrete arch has another advantage in that the materials and labor for its construction are nearly always procurable in the immediate vicinity; thus expenditures by counties or cities are largely for home labor and home materials; and the greater part of the fund for such improvements is retained by residents of the locality, instead of going to outside parties. The recent organization of a steel bridge trust capitalized in New Jersey at $70,000,000, adds weight to this feature of the comparison.

The final argument in favor of concrete arches is appearance. Concrete adapts itself readily to the arch; it is easily formed into ornamental mouldings, fillets, etc., which enable the designer to bring out the graceful lines of such a structure. The

white arch blends handsomely with the green of foliage, and the blue of water.

Fig. 6 is a view of the new Melan concrete arch at Topeka, Kan., and illustrates the possibilities of concrete in ornamental construction.

To summarize then, the concrete arch has the advantages of durability, increasing strength with consequent safety; freedom from the necessity for painting and repairs; employment of home labor and materials in its construction; and a handsome appearance that meets the popular demand for more handsome structures as the country grows older. It has the single disadvantage of expensive construction.

It is not putting it too strong, therefore, to say that as our country develops, and the demand for more permanent, substantial and ornamental bridges increases, trusses of steel will give place to arches of concrete, just as wooden bridges gave way to trusses of steel.

Incorporated, Globe Asphalt Co. of Pittsburg, Pa., capital $1,000,000 of which $10,000 is subscribed.

Five thousand barrels of Atlas Portland cement were rejected and ordered off the work at Tafts, near Norwich, Conn., where a large dam is under construction. The contractor, Mr. E, purchased 4,200 barrels of "Haccourt," an artificial Belgium Portland, which was accepted for the work. The Atlas mills are in effect surrounded by tarred rope as a warning not to trespass on the sacred grounds within. Legend and tradition inform us that Atlas was turned into stone as a punishment for acts of inhospitality, testifying to the fact that "the mills of the God grind slow but sure."

The Northern Pacific railway company has constructed 600 feet of dock on the water front at Tacoma, Wash., and owing to the rapid destruction of submerged piling by the Toredo which bores into timber, the company has taken the precaution to protect all piling with Portland cement concrete. The work was done as follows: Several piles are driven closely together and sawed off at the line of mean high tide. A casing of planks is then built around them and concrete deposited in the enclosed area entirely surrounding the bunch of piling, thus interposing a sheeting of concrete between the piling and water infested by the Toredo. The finished pier is about five feet in diameter. Heretofore metal has been used to protect timber from the attack of the Toredo. The use of concrete we believe will be found more durable and cheaper in the end.

A PROPOSED CHICAGO TRANSIT SUBWAY.

By C. G. Hastings.

The present overcrowded conditions of the streets in the business district of Chicago clearly demonstrates the pressing need of a suitable transit loop subway system within which the surface lines may be operated and thereby bring the much needed relief desired. Such a system has been frequently discussed. The plans we herewith submit makes ample provision for the present and future requirements of the city's transportation facilities.

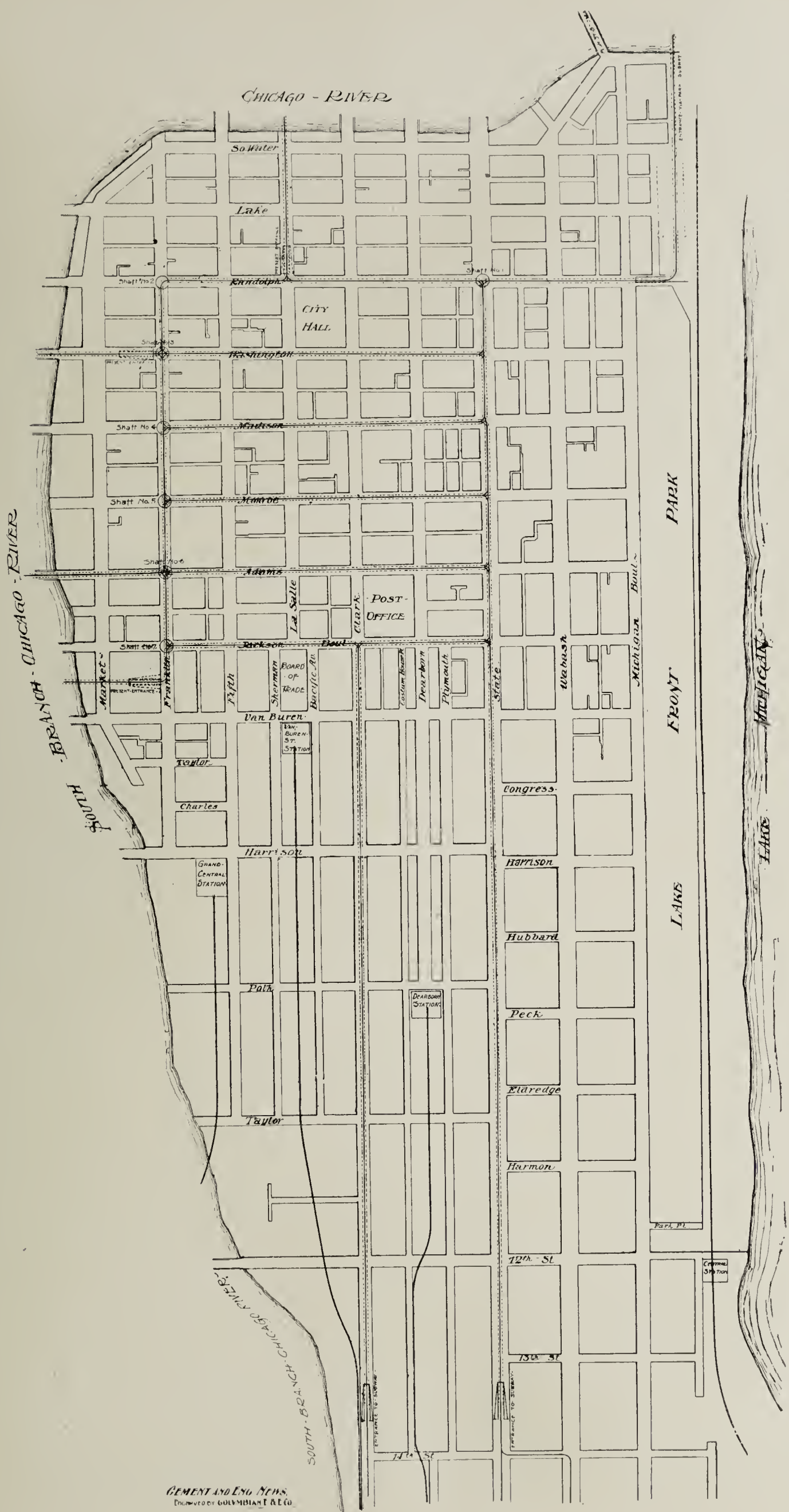
In the construction of such a subway the many difficulties to be encountered have been carefully weighed in the plans submitted whereby the least possible inconvenience to surface traffic may occur during construction, therefore a deep level subway is proposed, passing entirely beneath the present gas, water and sewer service which is to be maintained intact during the progress of the work.

The accompanying plat shows the route of the outer boundaries of the loop as well as the independent loops as follows: From Jackson north on State street to Randolph, west on Randolph to Franklin, south on Franklin to Jackson, thence east on Jackson to State. Thence by using all the east and west streets within the loop except Quincy as independent loops for the different lines to operate as convenient. The loop would be entered by the different lines as follows: North Side lines via La Salle street tunnel and proposed Park subway; West Side lines via Washington and Van Buren street tunnels and later by a tunnel at Adams street. South Side lines, including all lines now operating on Wabash avenue and State street via the State street tunnel at Fourteenth and State; also line operating on Clark street to enter a tunnel at Fourteenth and Clark streets, all as shown, as feeders to the loop for South Side lines.

The tracks which the different lines will operate within the loops may be arranged by the several companies using them, for which ample provisions are made by the double track system and switches, which meet every requirement under the heaviest traffic conditions.

For the construction of the work the plans show a lining of the following materials: An outer wall of cast iron erected in a segmental form to not be less than $1\frac{1}{2}$ inches thick with flanges about 7 inches deep, suitably bolted together. Steel segmental forms may be substituted for cast iron. The segment plates should then be at least $\frac{3}{4}$ inch thick and flanged about the same as the cast iron segments and reinforced by means of brackets made to fit at right angles with the flanges of segment shown in Fig. 2. The brackets serve a temporary purpose only, to stiffen the wrought iron segment against the thrust exerted by the hydraulic jacks used in moving the tunneling shields forward. The brackets are removed from the segments when the segments are safely beyond the area of pressure exerted by the jacks, thereby a limited number of brackets only are required, and are used over and over again. The cast iron segments will require heating to sufficiently open the pores that when dipped in tar bath to saturate the pores of the iron and thus prevent rust. Elastic water proof pads will be used in all circumferential and longitudinal joints. The entire external surface of the iron lining will be enveloped by layers of asphalt waterproofing, then an inside lining of concrete not less than 12 inches thick constructed as follows: First, after the iron segments are in place and forming the outer lining of the tunnel. Each segment as shown in Fig. 1 forms a suitable receptable to bond the concrete. When either a section, or the entire iron lining of the tunnel is completed, the concreting may be commenced. The concrete which is composed of one part first class Portland cement, two parts clean sharp sand and four parts crushed limestone mixed by machine, is spread over the iron lining and thoroughly tamped to a thickness of a 12 inch wall. A layer of expanded metal being imbedded therein, covered by a finishing coat composed one part of first class Portland cement and two of clean sharp sand troweled smooth.

Electric wires and gas main may be placed within the tunnels as shown in cross-section (B) with a sewer for the drainage of the tunnel. An emergency sewer and water system may also be placed in the tunnels as shown in cross-section (A) until such time as permanent conduits would be constructed suitable for water and sewerage at a level hereafter determined. The sewer shown in cross-section (A) is entirely of concrete bonded in form by means of cylinder of expanded metal, in case a sewer is deemed necessary. The water and gas main to rest on the concrete track bed. The bed timbers carrying the tracks may be of 10-inch by 10-inch hard pine pickled in tar before laying, to be imbedded in the concrete as shown in section (A) or may be of 4x16 inch hard pine from 16 to 20 feet long preserved as above and laid longitudinally on the concrete as shown in section (B).



Plat and Route of Proposed Chicago Loop Subway System. Plans and data by Cornelius G. Hastings, 1401 Monadnock Bldg., Chicago.

In the construction of the work I recommend the following method: Work to commence from five different openings; starting at or near the river on the line of the proposed Park subway, driving the tunnel westward to the shaft No. 2 at the corner of Randolph and Franklin streets; also starting at or near the east portal of Van Buren street tunnel, drifting north on Franklin to shaft No. 2. After passing the corner of Franklin and Jackson a third heading may be opened eastward to the line of State street. The shaft from which the State street tunnel would be driven may be located as shaft No. 1 corner of State and Randolph or at the entrance on State at Fourteenth street. If possible to operate from shaft No. 1 until the heading was under way, would be much better for the handling of material in the tunnel for this reason: By first driving the heading westward on Randolph beyond location of the shaft at State street, then drift southward on State street, all material may be passed via Randolph street drift to the opening at the river, hoisted to the surface and deposited into scows. By this means the materials passing in and out will be handled with the greatest economy with little inconvenience to surface traffic.

The same will apply to shaft at east portal of Van Buren street tunnel, where all the material in and out of the different headings of Franklin street and cross line tunnels in course of construction may be handled. Clark street would be opened near the point of entrance at Fourteenth street.

I suggest first constructing the four boundary street subways and Clark street as material advantage will be gained. First, in passing the different materials as heretofore mentioned, and second, that in constructing four inside tunnels, namely: Adams, Monroe, Madison and Washington streets, starting from the shafts Nos. 3, 4, 5 and 6, as shown on plat, the material would then pass to and via Franklin street, which being completed to the open shaft where the plant is located at Van Buren street tunnel portal, from this point all matter from the headings can be deposited into scows as at Randolph. For the construction of the Clark street tunnel, arrangements may be made at the Fourteenth street opening to receive and dispose of the materials by means of the railroads convenient at that point.

The stations to be used in connection with the system would be within the buildings adjacent to the several tunnels; arranged so as to provide entrance and exit to trains from either side of street, and would be provided with stairways or elevators operated within the buildings.

During the construction of the work provision would be made for openings to the stations in the lining of the tunnels so as to render the least possible inconvenience to the progress of the work as follows:

As the location for each station is reached on the line of work, instead of erecting complete rings of the segmental lining, certain segments would be made specially to form an arched entrance, and two or more segments of each ring substituted by specially designed wooden segments to temporarily replace the iron until such time as the arch of the station has been erected. Work may thus be prosecuted on the tunnels with little inconvenience. With similar openings to conform to the diameter of the tunnels to be driven at right angles from the shaft and tunnel in course of construction.

With respect to the introduction of plans for a system of transit subways at a deep level, I would say that the following good reasons are sufficient to warrant such plans practicable and should be acceptable. First, That in constructing such a system in the crowded thoroughfares on which open excavation would prove most objectionable, it is therefore necessary to pass entirely beneath the present pipe and sewer system of the several streets to be tunneled, thereby unmolesting in any way any of the public facilities now on use, such as street railways, water, gas or sewerage, the latter services of which underlies the streets. The work of construction can also be prolonged indefinitely unobserved or obstructed by pedestrians or team traffic, both of which would cause no end of inconvenience to open work.

By underground construction little or no convenience is caused to the great mass of occupants of the surface passing in every direction, which must necessarily cause great inconvenience by a great open cut and the moving of excavated materials, also by the handling of the different materials of construction all of which can be handled in the tunnels with the least possible inconvenience to either the public or the progress of the work.

Another great advantage in executing work by tunneling is that bad or stormy weather gives no cause of inconvenience to the work, while in an open cut great inconvenience would be experienced, for instance, in case asection of work had been partly excavated and not properly protected during heavy rain or snow storms would cause great delay and inconvenience and perhaps result in serious damage as has often been experienced in similar cases.

The streets designated on the plat to be tunneled, present the most convenient routes to the public patronizing the various lines, as well as the companies operating thereon in and through the heart of the city. The route is also chosen to least obstruct the foundations of the elevated loop, during construction of tunnels.

Provision for ample space is to be made in the tunnels for corporations having underground right of way to use the tunnels as compensation for rights surrendered on the line of the work.

Taking into consideration the character of the strata underlying the area as described, show that the work may be prosecuted under the modern methods of tunnel construction.

It is desirable that the City of Chicago may in the early future enjoy a system of underground railway, such as will be in operation in other large cities.

I respectfully invite the co-operation of all who may be interested in the promotion of a suitable underground transit system.

The Ajax Portland Cement Co. has been incorporated at Jersey City, N. J.

The Canadian Portland Cement Co. Ltd. of Deseronto, Ont., capital $1,500,000. E. W. Rathbun and others incorporators.

Rev. Dr. Henry Mosser has discovered vast deposits of cement rock 70 feet deep at Stouchsburg, Lebanon Valley, Berks county, Pa.

Concrete piles are being used on the Southampton docks, England, they are driven into place by steam pile drivers just as wooden piles are.

Baldwin, Mich., the site of the Great Northern Portland cement works is experiencing a great real estate boom on account of the location of the above named plant.

The employees of the Glens Falls Portland cement works struck for an increase of 25 cents per day as an offset against a percentage deducted by the company from the men's wages, which was to be applied for accident insurance. After mutual concessions the strike terminated.

Edward L. Cox has resigned his position as general sales agent of the Kelley Island Lime & Transport Co., which he has held for the past five years, to accept the position of general sales agent of the German-American Portland cement works, whose extensive plant at La Salle, Ill., will soon be in operation.

GERMANY.

EXPORT OF CEMENT IN TONS.

TO	APRIL.		JAN.-APRIL.	
	1899	1900	1899	1900
Freeport, Hamburg	456	1,359	1,812	4,547
Belgium	525	302	1,615	1,500
Denmark	1,048	1,386	2,399	2,415
Great Britain	125	304	394	1,300
Holland	3,413	5,697	11,994	15,066
Norway	2,006	1,545	4,309	4,042
Austria	1,974	1,748	5,358	4,237
Russia	1,286	260	1,617	511
Finland	1	17	20	272
Switzerland	1,358	718	3,731	2,133
Cape Colony	358	328	2.059	1,569
Transvaal	1,404	85	3,582	255
China	3,984	263	10,944	3,399
Other East Indies	773	1,020	3,765	3,894
Argentine	4	1,029	4,620	5,988
Brazil	745	1,141	4,305	6,009
British North America	193	688	516	942
Chili	545	551	2,354	1,982
United States	16,815	23,501	56,219	87,781
Australasia	2,950	1,742	10,574	10,615
Totals, with others	42,133	48,549	140,252	172,236
1898	35,779	.....	130,796	.....
1897	49,353	.....	127,385	.....

BELGIUM.

EXPORT OF CEMENT IN TONS.

TO	APR.	JAN.-APRIL.		
	1900	1900	1899	1898
Germany	244	1,337	1.270	1.565
Great Britain	7,339	20,607	25,656	10,162
Australasia	410	514	4,566	1,253
Brazil	872	8,739	3,823	7,854
Canada	1,904	1,981	797	1,466
Cape Colony	188	1,067	953	1,739
Chili	46	194	246	644
China	229	1,438	1,450	3,021
Cuba and Porto Rica	256	1,931	1,547	183
Egypt	1,037	4,607	3,248	1,436
Spain	726	2,166	1,765	1,450
Congo Free State	11	353	327	132
United States	13,406	34.501	26,848	31,309
France	1,526	4,300	3,127	2,895
British East Indies	964	2,217	3,194	2,260
Japan	.....	12	382	3,008
Mexico	299	2,105	1,748	385
Natal	161	162	2,876	413
Norway	613	2,008	2,403	1,008
Holland	5,280	14,273	12,045	12,113
Portugal	454	1,915	1,156	1,205
Argentine	2,797	10,890	12,127	10,215
Roumania	86	105	891	266
Russia	15	17	458	507
Turkey	.....	42	171	33
Uruguay	.....	61	248	72
All others	762	4,168	4,441	3,371
Total (kils.)	.....	121718	117,777	100,031
April only	39,635	.....	46,377	27,072
Full years	.....	.....	449,936	419,131

ENGLAND.

CEMENT SHIPPED FROM PORT OF LONDON, April, 1900.

TO	TONS	TO	TONS
Adelaide	112	Madras	98
Alexandria	9,297	Mauritius	312
Amsterdam	108	Melbourne	822
Antwerp	11	Mornbassa	120
Auckland	143	Montevideo	275
Baltimore	89	Montreal	1,868
Beunos Ayres	1,252	Mossel Bay	108
Bahia	84	New Orleans	252
Bangkok	8	Newport News	191
Barbadoes	180	New York	206
Beira	45	Ostend	4
Bermuda	152	Otago	53
Beyron	9	Penang	268
Boca	390	Pt. Elizabeth	996
Bombay	997	Puget Sound	213
Boston	210	Quebec	50
Brisbane	110	Rangoon	194
Cain	2,038	Rio Janeiro	203
Calcutta	3,672	Rockhampton	185
Capetown	481	Rosario	49
Channel Isles	63	Rotterdam	206
Colombo	446	Rorlen	50
Constantinople	27	San Francisco	4,009
Demerara	398	Santos	268
Dunkirk	1	Singapore	3
Durban	1,099	St. John, N. B	50
East London	1,376	St. John's, N. F	417
Galatz	30	St. Lucia	17
Gibraltar	2,470	Surinam	24
Grenada	10	Sydney	15
Halifax	370	Sydney, C. B	4,637
Hamburg	73	Trinidad	660
Harlingen	38	Vancouver	419
Hongkong	89	Vera Cruz	2 255
Jamaica	346	Victoria, B. C	257
Kobe	536	Wellington	442
Kunachee	500	Yarmouth, N. S.	100
Launceston	45		

UNITED KINGDOM.

EXPORT OF CEMENT IN TONS.

TO	APRIL.		JAN.-APRIL.	
	1899	1900	1899	1900
Holland	240	406	1,197	1,379
United States	3,668	7,075	5,581	19,503
Brazil	309	1,408	4,498	4,287
Argentine Republic	1,336	1,578	5,843	5,749
British South Africa	971	3,603	11,984	11,838
British East Indies	4,499	2,273	17,132	16,565
Australasia	1,446	3,000	10,297	9,222
Canada	1,792	1,611	2,158	3,488
All others	9,125	14,140	42,395	51,613
Totals	23,386	35,094	101,085	123,644

Exports of cement for April, 1898, were 29,873 tons; from January to April, 1898, 114,339 tons.

CEMENT IMPORTED INTO THE UNITED KINGDOM.

From December 1, 1899 to February 27, 1900.

FROM	TO	TONS.	£
Antwerp	Liverpool	140	300
"	"	32	70
"	"	100	158
"	Bristol	14	23
"	"	11	20
"	"	178	103
"	Cardiff	202	302
"	"	49	74
"	Goole	115	220
"	"	60	114
"	"	49	93
"	Grimsby	10	100
"	Manchester	50	75
"	"	10	15
"	Middlesboro	100	200
"	Newcastle	13	26
"	Preston	215	322
"	Southampton	44	66
"	Sunderland	336	671
"	Douglas	133	200
"	Glasgow	170	499
"	"	435	1,306
"	"	327	981
"	"	255	766
"	Grangemouth	236	420
"	"	256	475
"	Belfast	130	195
"	Dublin	30	60
"	"	50	73
"	Ramsey	88	101
Brussels	London	50	70
"	"	86	130
"	"	67	101
Boulogne	Cardiff	51	76
Copenhagen	London	5	10
Ghent	"	50	90
"	Liverpool	95	210
"	Goole	10	19
"	"	10	19
"	Hull	80	405
"	"	219	870
"	"	86	340
"	"	110	330
"	Manchester	177	244
"	"	51	75
"	"	59	89
"	Newcastle	53	105
"	Sunderland	250	500
"	Ayr	732	1,038
"	Leith	100	125
"	"	150	187
Hamburg	Dundee	100	325
Nieuport	Ramsgate	90	135
Rouen	London	90	270
Rotterdam	Aberdeen	300	600
Stettin	Manchester	50	69
Temeuzen	Teigmouth	125	239

UNITED KINGDOM.

EXPORT OF CEMENT IN TONS, APRIL, 1900.

TO	TONS	TO	TONS
Albany	1,296	Larnaca	10
Alexandria	4,154	Lisbon	179
Amsterdam	512	Lyttleton	330
Auckland	134	Madras	45
Buenos Ayres	1,578	Malta	146
Bahia	184	Mauritius	83
Barbadoes	146	Melbourne	259
Bermudas	27	Montreal	298
Bluff Harbour	27	Nagaski	248
Bombay	418	Napier	45
Boston	13	Nelson	98
Brisbane	178	Newcastle, N. S. W.	178
Baltimore	54	New Orleans	89
Calcutta	517	Newport News	501
Canada	35	New York	171
Capetown	1,204	Odessa	32
Channel Isles	302	Otago	54
Chinde	6	Penang	38
Cologne	7	Port Elizabeth	1,580
Colombo	549	Rangoon	623
Constantinople	36	Rockhampton	54
Demerara	411	Rotterdam	224
Durban	464	Rouen	50
East London	173	San Francisco	2,841
Galatz	20	San Diego	3,576
Gibraltar	2,500	Santos	268
Gothenburg	4	St. John, N. B	33
Halifax	218	St. John, N. F	154
Hamburg	210	St. Lucia	18
Harlingen	27	Sydney	833
Havana	689	Trinidad	439
Hobart	87	Vancouver Isle	84
Hongkong	5	Vera Cruz	331
Jamaica	347	Vladivostock	379
Kunachee	44	Wellington	143
La Guayra	15		

IMPORT OF CEMENT INTO UNITED KINGDOM, 1900.

MONTHS.	TONS.	VALUE £
January	3,934	8,082
February	7,018	14,857
March	5,401	12,213
April	7,918	17,694

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IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	APRIL.				TEN MONTHS ENDING APRIL.			
	1899.		1900.		1899.		1900.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom	2,098,400	8,418	26,057,000	103,084	98,388,130	356,056	88,710,294	350,596
Belgium	14,499,645	39,731	32,279,908	67,161	221,143,933	659,053	240,335,664	689,327
France	.....	.....	1,488,052	6,074	5,418,800	16,829	5,885,397	22,669
Germany	36,536,489	134,445	36,691,748	183,249	340,824,423	1,197,977	392,222,510	1,455,991
All Other Europe	2,199,435	6,663	4,541,628	12,798	18,307,487	41,544	23,349,240	74,297
British North Am.	103,325	526	75,800	106	1,146,445	5,255	973,590	5,217
Other Countries	.....	.....	662,000	2,921	2,000	9	4,103,160	19,373
TOTAL	55,437,294	189,783	101,796,136	375,393	685,231,218	2,270,723	755,579,745	2,617,470
Domestic Exports of Cements, bbls.	10,173	20,158	7,863	19,103	50,420	104,003	62,115	133,193

There were 5,906,210 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on April 30, 1899, valued at $18,272, against 11,245,564 lbs., valued at $41,339 in April, 1900.

Imports of asphaltum or bitumen for April, 1899, were 7,205 tons valued at $19,688; April, 1900—7,661 tons valued at $29,701. For ten months ending April, 1899, 49,489 tons valued at $154,762; for ten months ending April, 1900—87,348 tons valued at $279,272.

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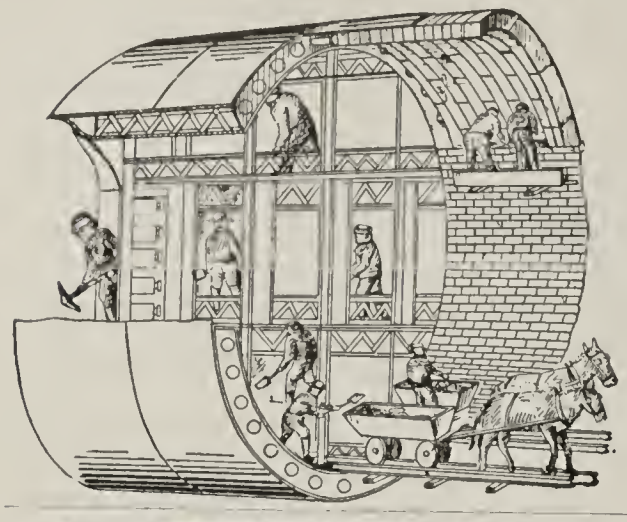

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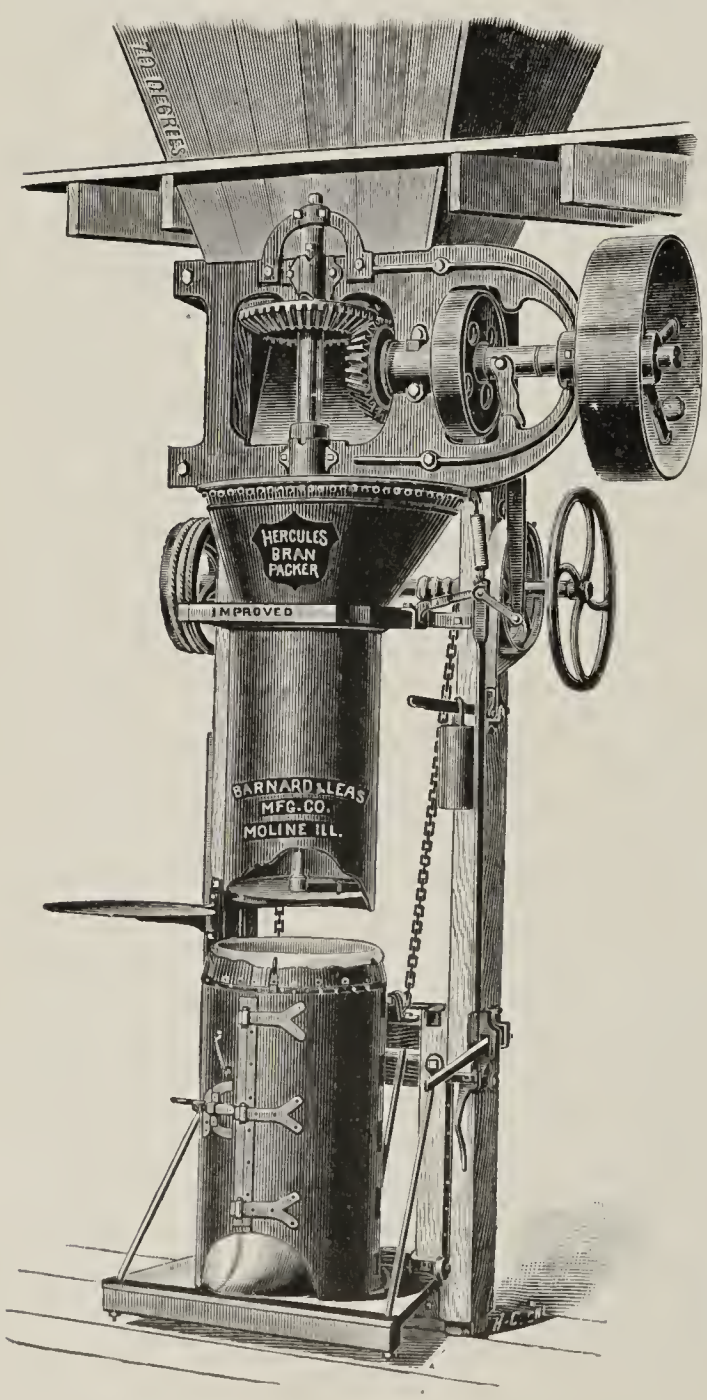

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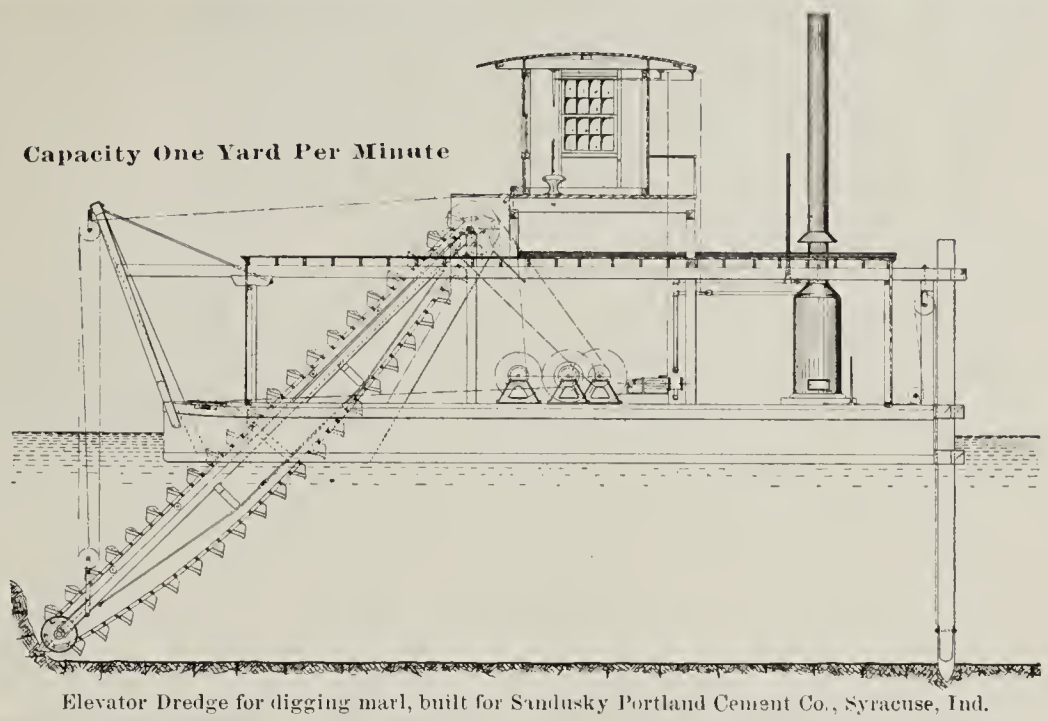

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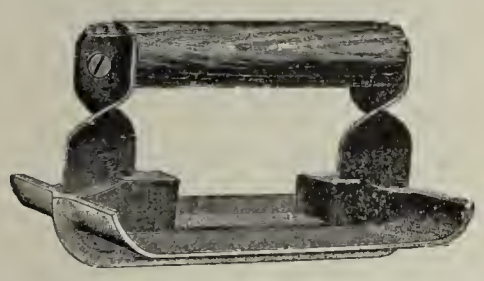

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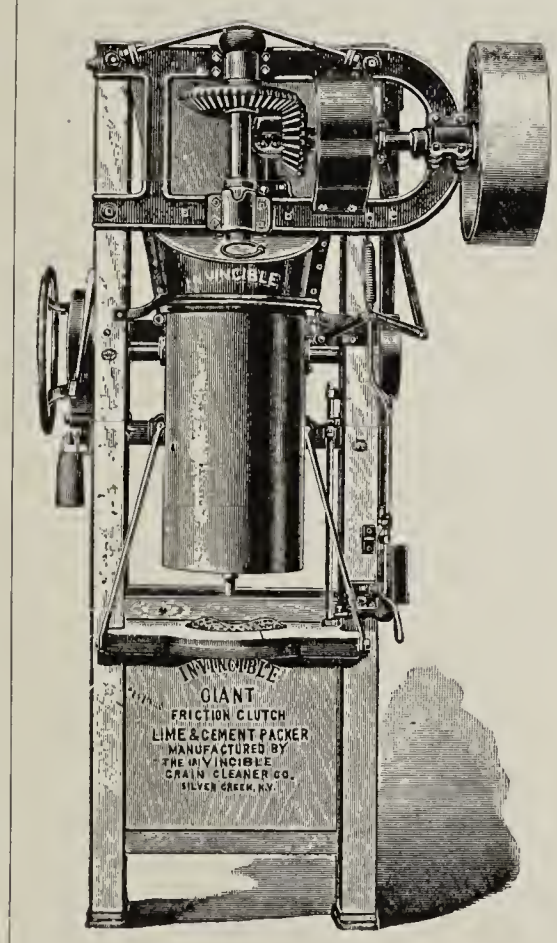

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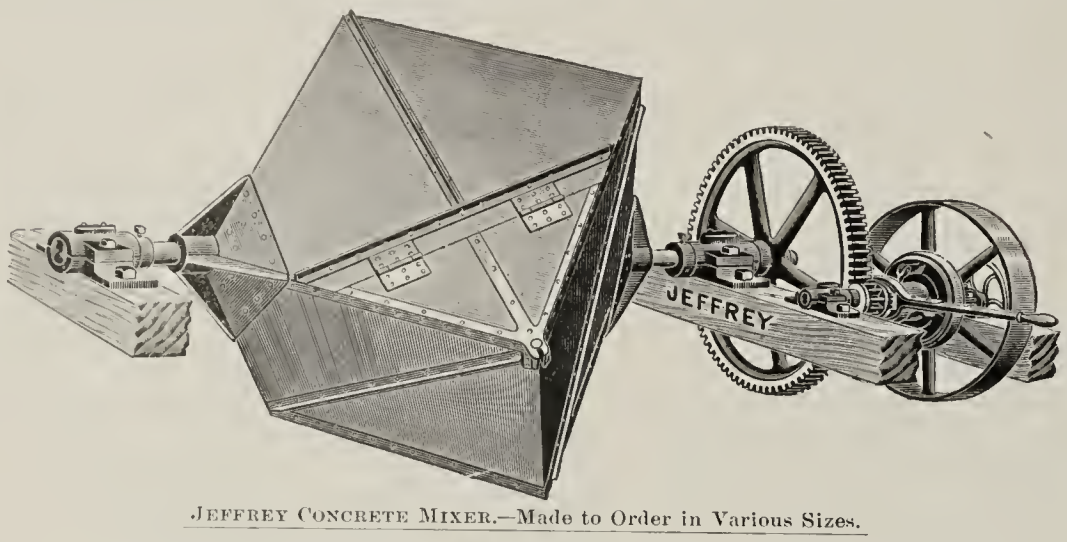

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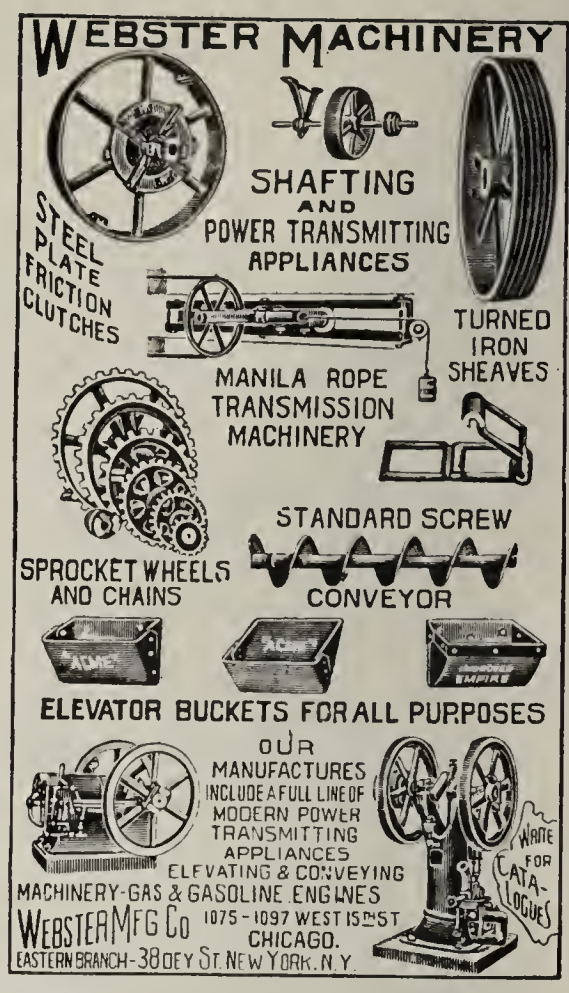

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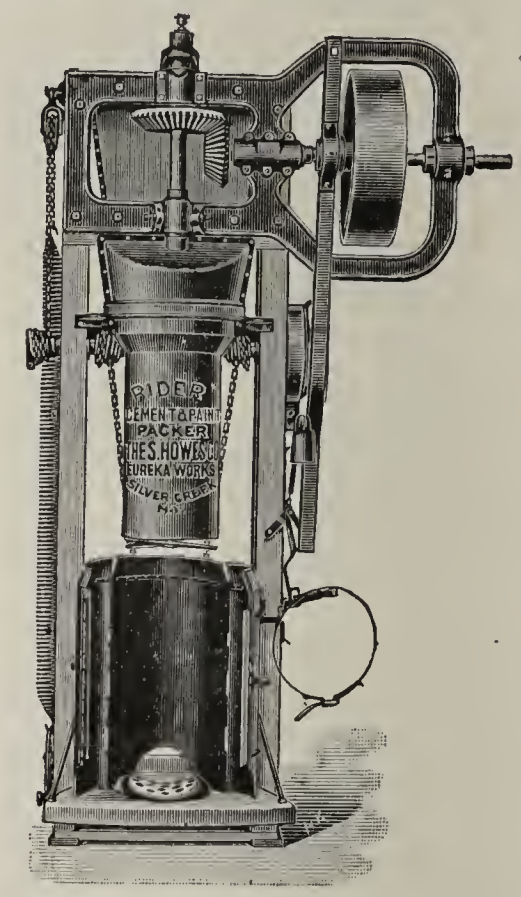

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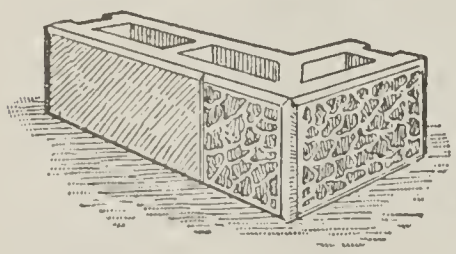

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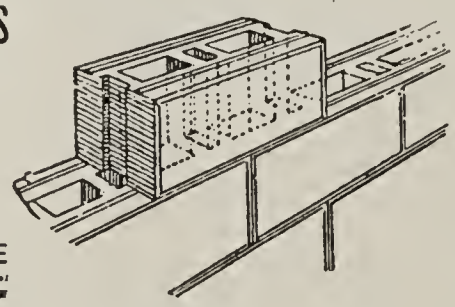

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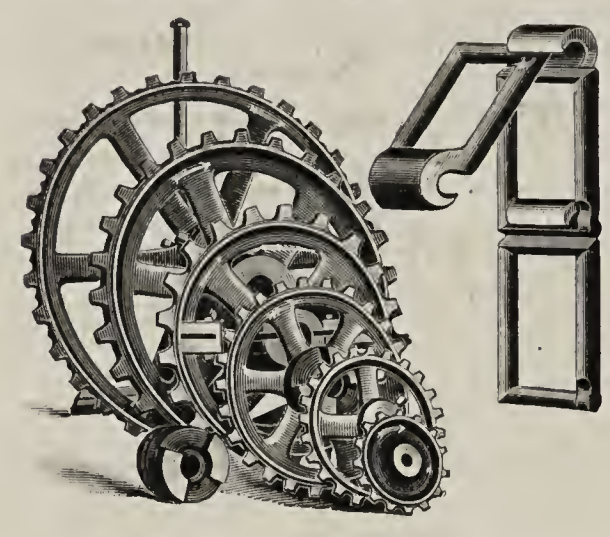

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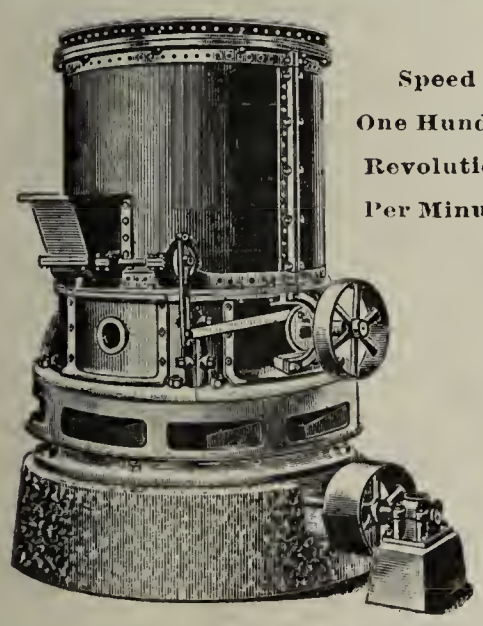

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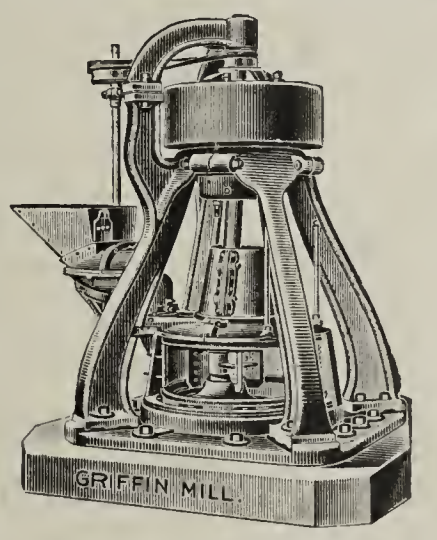

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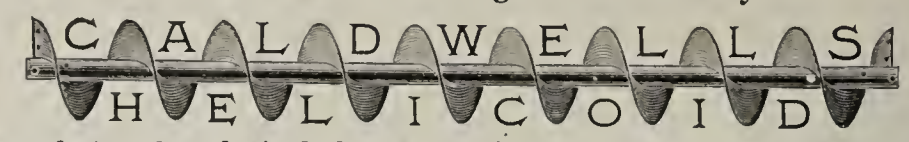

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ENGINEERING NEWS

CONCRETE CRIB CONSTRUCTION AT THE CHARLESTOWN NAVY YARD.

Our illustration shows the method of erecting cribs for use in the new dock being built for the joint use of the Fitchburg Railroad and the United States government, adjoining the Charlestown Navy Yard, Boston, Mass. The crib consists of a framing of logs with the ends projecting. Common boards are nailed directly upon the logs, forming the inner sheeting. Expanded metal is stretched across the face of the crib frame in line with the projecting ends of the logs, a second wall of broad sheeting is next erected outside of the expanded metal, leaving a space on either side of the expanded metal; into this space the concrete is deposited, forming the outer crib wall. No. 4 gage 6-inch mesh galvanized expanded metal is used in this work. The cribs are built on land and floated to the spot over which they are to rest and sunk in place. The Fitchburg Railroad Company pays for the cost of the new dock. The work is done under the supervision of the United States engineer corps. In all, about 50,000 square feet of expanded metal has been used in the work to the entire satisfaction of the U. S. officials in charge.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

PORTLAND CEMENT STREET PAVEMENTS.

No substantial reason exists against the use of Portland cement pavement for street and roadways in the United States.

The points raised against its use disappear on close examination. While it is true that Portland cement concrete pavements do not possess every point of superiority over every other kind of paving material, compared with asphalt it is not so elastic under the tread of horse and wheel traffic, yet it is equally smooth and far more durable. Carefully conducted abrasion tests made on a stone rubbing bed at Philadelphia and described in this journal demonstrated that a Portland cement concrete block suffered less from abrasion than granite. We have therefore in a Portland street pavement the smoothness of asphalt with the wear resisting properties of granite. No other paving material can show like properties, therefore it should be used. The city of Philadelphia, we are pleased to note, is and has been for some time using Portland cement concrete pavements in all its alleys with entire satisfaction. It makes a perfect sanitary pavement. Berlin, Germany, has commenced laying it. The city of Grenoble, France, is likewise using Portland cement pavements on all streets in preference to all other paving materials on its intrinsic merits.

There are numerous streets in the city of Chicago originally paved with asphalt on concrete foundations from which the asphalt has entirely disappeared leaving the concrete foundation exposed and in good state of preservation, one particular street in which the foundation is of Utica hydraulic cement concrete, denuded of its asphalt covering for more than eight years and over which much of the heavy structural iron was hauled for the Metropolitan Elevated railway, shows little or no wear. Here and there slight depressions exist due to the introduction and repairs of the street, water and gas service, otherwise the street is in good condition.

The adoption of concrete street pavement is simply a matter of time and of educating the people to its use and economy.

Julius Cæsar built military roads of concrete in Europe which exist in part to-day under the traffic of two centuries.

SEVEN HUNDRED AND FIFTY MILLION BARRELS OF CEMENT FOR CHICAGO ON PAPER.

We have before us a supplemental prospectus purported to be issued by the Monolith Portland Cement Company which contains various wild statements relating to the present and future state of the American Portland cement industry, evidently designed for circulation among backwoods constituencies.

This prospectus invites criticism and refutation on the broad plane of sound business policy.

We abstract only a single item for criticism, to-wit:

"Construction under way in Chicago to-day will require for its completion (750,000,000) seven hundred and fifty million barrels of cement."

This statement is absurd. The entire Portland cement output of England in 1899 was about 9,000,000 barrels of 350 pounds each. It would take the entire English output for eighty-five years to fill the order for 750,000,000 barrels for the work claimed to be under way in Chicago. The United States produced in 1899 about 6,000,000 barrels of Portland cement. On this basis it would require one hundred and twenty-five years to fill the single order for Portland cement on work reputed to be under way in the city of Chicago.

The world's output of Portland cement since its discovery has not reached 750,000,000 barrels.

The Monolith Company have injured no one but themselves in the eyes of conservative capital in putting forth its supplemental prospectus. The sooner it is withdrawn from circulation and recast upon lines more consistent with actual facts, the sooner will its projectors float the magnificent project marked out.

A NEW PORTLAND CEMENT PLANT AT FENTON, MICH.

Messrs. Lathbury & Spackman have been retained by the Detroit Portland Cement Company to design a plant having a capacity of 1,000 barrels of Portland cement per day, to be erected at Fenton, Mich., on the Chicago & Grand Trunk Railway. This plant will be equipped and operated exclusively with electricity, the various machines being directly connected to motors, obtaining their current from a central power house. This firm is also erecting at present the large plant to have a capacity of 1,500 barrels per day for the Alsen's American Portland Cement Works at West Camp, N. Y., located on the Hudson river, and which will be entirely equipped with electrical power. The transmission of power by electricity applied to the manufacture of Portland cement is of recent date. The success attending the first installation of electrical equipment in the plant designed by them for the Alma Portland Cement Company, warranted the erection of plants with larger capacities for operating exclusively with electricity. The direct current with 220 volts is used. In efficiency and economy, it appears to be the coming equipment for the cement industry, and we will no doubt see many new plants in the future designed entirely for electrical transmission of power, and probably the gradual substitution of electricity in the older plants now in operation.

A new Portland cement plant is to be erected at New Ithaca, N. Y. The papers have been signed for the purchase of the land, Estimated cost of works $200,000.

WHITE PORTLAND CEMENT.

By Dr. W. Michaelis, Jr.

The subject of producing a white Portland cement has from time to time engaged the attention of cement chemists with a view of its manufacture on a commercial scale. So far it is simply a laboratory product. The demand for such a cement already exists and its application would be more varied than that of an ordinary Portland. It would be especially suitable for interior plaster decoration, wainscoting, floor-tiling, for laying fine brick and mason work and as a substitute for marble. In its production raw materials of the highest purity only can be used, which do not contain the slightest trace of iron or manganese, that is to say the task given is to burn a cement out of the purest limestone, chalk or marl and pure white kaolin. The resulting cement is then indeed white as snow, and a broken briquette will show a fractured surface as white and smooth as the finest broken porcelain.

The conditions under which white cement may be produced, are quite different from the ordinary Portland cement manufacture, inasmuch as there are many difficulties to be encountered in the simple making of test burns, that it will prove almost impossible to burn a uniform cement, when carried into actual practice for commercial purposes. The aim of the following is to show wherein the burning of a white cement differs from the burning of an ordinary Portland cement. The data given are drawn from test burns made by the writer under the most varying conditions.

Experimental test burns of white cement have been made heretofore. The chemists however in making such tests did not consider it necessary to examine how far removed these experiments were from the plane of actual practice, principally in regard to the high temperature required for vitrifying white cement material.

The raw materials for our purpose are kaolin and carbonate of lime. Pure kaolin of the composition Al_2O_3, $2SiO_2$, $2H_2O$ contains: 14% Water, 46% Silica and 40% Alumina. This material mixed in the proper proportion with a marl of 99 per cent carbonate of lime will yield a cement of the following composition: Silica 20%, Alumina 13% and Lime 67%. In burning this mixture we find that on account of the entire absence of iron, the material is very difficult to flux, when compared with ordinary cement material. When passed through a 100 mesh sieve, which is amply sufficient for an ordinary cement, this raw mixture requires a temperature of about 1,700 centigrade in order to be vitrified. It must be passed through a 200 mesh sieve and requires even then a temperature far higher than 1,400 centigrade, the ordinary burning temperature in our kilns, as determined by Le Chatelier. The resulting cement sets very quick on account of the high content of alumina and has no great tensile strength. Besides the vitreous clinker is so hard and dense that the grinding would be very costly.

Hence it is evident, that a white cement cannot be produced in this way on a large scale. Pure kaolin would be a very expensive raw material and the grinding of the raw mixture, so that the whole passes a 200 mesh screen, and moreover the grinding of the hard clinker would so increase the cost of production that the price of a barrel of such a cement would be several times higher than that of an ordinary cement.

Therefore in order to reduce the cost of manufacture we must have recourse to a substitute for the pure kaolin and adopt a kaolin containing from 50 to 70 per cent quartzsand. This sandy kaolin existing in abundance and being worthless for porcelain manufacture can be obtained at as low a first cost as an ordinary clay. In the application of this raw material for a chemical reaction with carbonate of lime the following points must be taken into consideration. The analysis of such a sandy kaolin, assumed to contain 60 per cent quartzsand, will show that it is composed of about 5% Water, 75% Silica and 20% Alumina. From a theoretical point this would be the best raw material for a white cement, as the content of alumina, which was as high as 13 per cent in a cement made out of pure kaolin, will now be much reduced, so that the finished cement will have the following composition: Silica 24%, Alumina 6%, Lime 70%. In practice however it proves to be of great disadvantage, that 60 per cent of the silica consists of quartzsand and that only the remaining part belongs to the clayey substance and is chemically combined with water and alumina. In the manufacture of an ordinary cement only a very low percentage of the finest quartzsand is allowed to be present in the raw mixture, because otherwise it would be impossible to vitrify the material. Here our task now is to clinker a raw mixture with about 20 per cent quartzsand. In order to bring silica in this state into chemical combination with other materials, the finest possible grinding is required. The raw material must be ground so fine as to pass a 200 mesh sieve. All experiments to combine quartzsand of a coarser grain with lime have utterly failed, as there is always a corresponding percentage of free lime present for every per cent of silica which did not enter into chemical reaction. The resulting material was therefore either a hydraulic lime or, when the temperature was carried as high as 1,600 to 1,700 centigrade in order to force into combination even the coarse grained silica, an overburnt material was obtained, which regularly disintegrated while cooling. Assuming that the market value of a white cement would be twice the value of the best Portland, the costly grinding to the fineness of a 200 mesh sieve would no longer be a serious obstacle in its manufacture, and we have then next to consider the proper proportions of the raw mixture and to ascertain the temperature required to vitrify the finely ground material.

In regard to the composition the best cements gave the analysis: Silica 24%, Alumina 6%, Lime 70%. When the lime was carried higher, free lime was always present in the finished cement, which very soon showed signs of destruction. When the content of silica was increased, the burning was extremely difficult, an intense white heat being necessary, and the cooling clinker crumbled into powder. In this way the experiments were confined to a raw mixture of the composition above referred to, which was found to yield cement of high tensile strength, and the utmost care was now taken to examine how this laboratory product would probably behave in practice, where it is not always possible to maintain the conditions so regular as can be done in a laboratory experiment.

That the vitrification of white cement material must take place at a temperature which is more definite and limited than the burning temperature of an ordinary cement already follows from the single deliberation, that here no iron is present, which at a comparatively low temperature starts the fluxing and forms by its compounds with silica and lime the fusible ground mass, in which bye and bye the more refractory substances can enter into combination. In the case of the white cement material this ground mass, which promotes and facilitates the action of lime on silica and alumina, is absent and therefore the vitrification takes place at a certain limited temperature, a fact, which causes the greatest trouble in the burning of this material, and which will probably destroy all hope of the production of a white cement on a commercial scale. So the writer has found

that 1,550 centigrade are required in order to thoroughly vitrify the raw mixture. 1,550 centigrade must be reached. If the temperature remains only a little under this figure, say at 1,500 centigrade, the clinkering is not complete and free lime is present in large amounts. On the other hand, when the temperature is raised to about 1,600 centigrade overburnt material is always obtained, which disintegrates while cooling.

Supposing a kiln could be found, in which it would be possible to obtain with forced draught and regenerated heat a temperature of 1,550 centigrade, I maintain it would be impossible to keep the temperature so uniform, that this short interval of temperature will not be surpassed.

In regard to the fuel used the best might be gas; even ashes of charcoal would injure the finished cement by discoloration.

The experience deduced from the foregoing experiments suggests, that before this cement could be produced commercially, a suitable kiln must be available, in which the required temperature can be maintained constant. In the meantime investigations should be directed to the finding of some material, which, when added to the raw mixture, will bring down the temperature of vitrification so far that the cement material can be burnt in an ordinary kiln, for example in a rotary kiln with gaseous fuel.

At the present time there is little likelihood of its realization and chemists should be cautioned not to conclude from a few successful laboratory experiments, that the matter is ripe for practice. Unfortunately the tendency exists with American cement chemists to deduce rules for general application from a few tests made under quite special conditions and to recommend formulas which in actual practice prove to be of little or no value.

Incorporated: The St. Paul Cement Works of St. Paul, Minn., capital $10,000.

The Newaygo Portland Cement Co. of Newaygo, Mich., laid the corner stone for its new plant June 28th in the presence of the entire village and farming community from the surrounding country. Wm. Wright, vice-president of the company delivered an appropriate address. A ball game and balloon ascension in the afternoon and fireworks in the evening in honor of the event closed the celebration. The Newaygo Portland Cement Co. is strongly financed and own a 1,500 horse power water power. The works will have a capacity of 1,000 barrels per day.

NEW PLANT OF H. W. CALDWELL & SON CO.

We present three illustrations of the new modern and extensive manufacturing plant of The H. W. Caldwell & Son Co. of Chicago, located on Western avenue between 17th and 18th streets, and consists of three main buildings as follows: The power house 56x73 feet, the main machine shop 106x180 feet, rolling mill and sheet metal department 100x180 feet. The power house contains two 175 horse power Geary water tube boilers, one 16x36 Allis-Corliss engine, rolling mill type, extra heavy for uniform speed under varying loads, one 100-kilowatt dynamo for lighting and power. The entire power house is equipped with the most modern appliances to secure economy and efficiency.

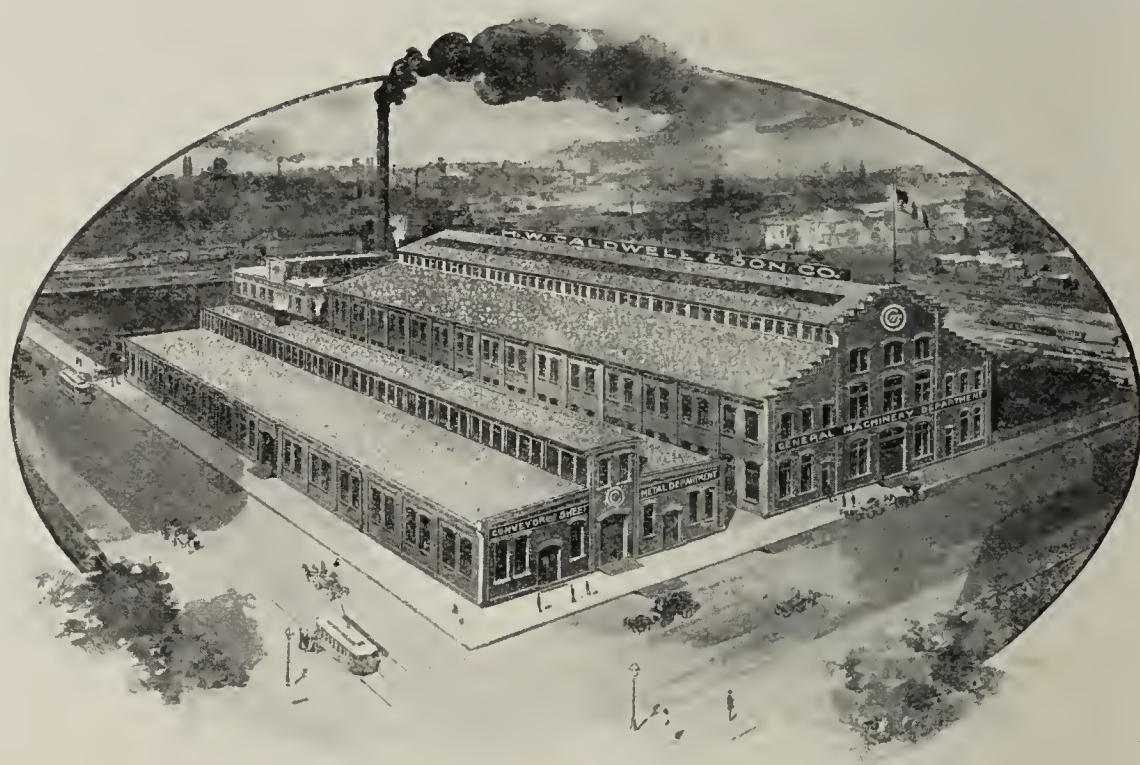
The machine shop walls are brick, the roof trusses and galleries at the side are of structural steel, the roof contains woven wire glass skylights extending the entire length of the room giving ample light. The pattern shop occupies the east gallery, the west gallery is adapted for machine shop, an electrically operated elevator with a platform 9x18 feet plys between the main floor and this gallery. The front gallery is devoted to the general offices of the company and the draughting room.

From either of these departments the entire shop can be viewed. The ground floor under the offices is used for assembling and shipping room a 48-foot span traveling crane twenty tons capacity carried on tracks extending the entire length of the open area between the galleries and outside over the switch tracks and thereby capable of receiving and delivering materials direct to and from the cars and distributing such materials onto either gallery or the open area on the ground floor. The crane is operated by electricity. The shop equipment of heavy and light metal working machinery is the most modern and labor saving obtainable. The machines are grouped so as to utilize only short line shafting and few bearings. The power is supplied to each group by individual electric motors.

The rolling mill and sheet metal department is devoted to the production of the Caldwell conveyor which has been the company's specialty for twenty five years.

A portion of this building is occupied by the rolling mill operated by electricity and used for manufacturing the Caldwell-Helicoid flight.

The furnaces are equipped with fuel oil apparatus of the latest approved type. The forge shop and blacksmith department and sheet metal department are equipped with shears, rolls and punches especially adapted for the manufacture of the various lines of Caldwell conveyors and other sheet metal specialties. The entire plant is heated by the hot blast system of heating and ventilating, the heat being supplied by exhaust steam from the engine. In summer cold water circulates in the coils and cools the air forced into the shop. The entire plant is lighted by arc and incandescent lamps. A foundry is yet to be erected as well as a warehouse three stories high to be used by the shipping department and for storage of finished goods. The plant has direct switching facilities connecting with five lines of railways and the Belt Line railway.



H. W. Caldwell & Son Co.'s New Plant, Western Ave., 17th and 18th Sts., Chicago.

Edison Portland Cement preferred stock has been assessed $10 per share, payable August 1. This will make $35 paid, par 50. The works are at Stewardsville, N. J.

AN ENGLISH CEMENT COMBINE.

We are in receipt of the prospectus of The Associated Portland Cement Manufacturers (1900), Limited of England, under date of July 12, 1900. The capital of the association is $25,000,000, of which the vendors take one-third.

We abstract the following from the prospectus:

This association was formed for the purpose of purchasing the undermentioned firms and companies engaged in the manufacture of Portland cement. With three exceptions, all the works are situated on the Thames and Medway, and possess all advantages in the quantity and quality of raw material, that the vicinity of these two rivers afford, being the cradle of the Portland cement industry and now the chief seat of manufacture. Upwards of 80 per cent of the entire output of Portland cement in the United Kingdom is produced on the Thames and Medway, where the supplies of chalk and clay are of the finest quality for its manufacture. The total production of cement on these rivers in 1899 has been estimated at 1,700,000 tons, whereas the estimate of production in 1895 was only 1,350,000 tons. This difference is due to the largely increasing demand for Portland cement.

Many of the firms whose undertakings are acquired are old-established, and possess brands and "trade marks" of the highest reputation throughout the world. The certified production of the firms taken over by this association was in

1897	1,222,240 tons.
1898	1,337,268 "
1899	1,404,569 "

The capacity of the combined works is now about 1,570,000 tons.

The following works were acquired between Sept. 30, 1899, and March 31, 1900, with negotiations for other works in progress, to-wit:

On the River Thames—John Bazley White & Brothers' Works at Swanscombe and Greenhithe; Hilton, Anderson & Brooks' Works at Grays; Knight, Bevan & Sturge's Works at Northfleet; I. C. Johnson & Company's Works at Greenhithe; Gibbs & Company's Works at West Thurrock, Grays; Francis & Company's Works at Cliffe; London Portland Cement Company's Works at Northfleet; Robins & Company's Works at Northfleet; Imperial Portland Cement Company's Works at Northfleet; Wilders & Cary's Works at Greenhithe; Weston & Company's Works at Northfleet; Macevoy & Holt's Works at Northfleet; Hollick & Company's Works at Greenwich; Laurence & Wimble's Works at Northfleet; New Rainham Portland Cement Works at Rainham; Tower Portland Cement Works at Northfleet.

On the River Medway—Hilton, Anderson & Brooks' Works at Upnor, Halling and Faversham; J. Bazley White & Brothers' Works at Gillingham and Bridge, Globe and Quarry Works, Frindsbury; Burham Brick, Lime and Cement Company's Works at Burham; Tingey & Son's Works at Frindsbury and Chalk Quarries at Wouldham; Booth & Co.'s Works at Borstal and Cuxton; McLean, Levett & Co.'s Works, Frindsbury and Elmley; Trechmann, Weekes & Co.'s Works at Halling; West Kent Portland Cement Works at Aylesford and Burham; Phœnix Portland Cement Works at Frindsbury; Borstal Manor Portland Cement Works at Borstal; Wouldham (Medway) Cement Works at Wouldham.

Outside Thames and Medway district—I. C. Johnson & Company's Works at Gateshead-on-Tyne; Chas. Francis, Son & Co.'s Works at Newport, Isle of Wight; The Arlesey Lime and Portland Cement Company's Works at Arlesey, near Hitchin.

In addition to the above, the association will have, on terms which have been agreed, working arrangements for three years or over with the following firms—Martin Earle & Company, Limited, Wickham, Medway; William Lee, Son & Co.; Wouldham Cement Company (1900), Limited at West Thurrock, Thames; Queenborough Portland Cement Company at Queenborough, Medway.

The association acquires about 89 per cent of the total capacity of production of cement on the Thames and Medway.

The management of many of the works for the present, will remain

H. W. Caldwell & Son Co.'s Rolling Mill and Sheet Metal Department, 100x180 feet.

H. W. Caldwell & Son Co.'s Machine Shop, 106x180 feet.

under the personal management of their present owners or managers. The executive control of the association's business will rest with the managing directors, who are practical experts in the trade, and most of whom have been actively engaged therein for over twenty years.

Some of the earnings are derived from other sources than the manufacture of Portland cement, viz., the sale of chalk, the manufacture of lime, whiting, bricks, Keene's cement, Roman Cement, etc.

The association will control leasehold wharves at Upper Thames street, London, and at Blackfriars, Pimlico, Westminster, Lambeth and Vauxhall.

An agreement entered into with George E. Wragge, on behalf of the principal London cement merchants, provides *inter alia* for all merchants joining them taking their whole requirement of cement from this association for the term of seven years.

Several of the larger cement works taken over have engineering works and repairing shops; and two additional engineering works have been acquired, one on the Medway, the other on the Thames, to economically carry out a great part of the association's repairs and renewals.

The association controls a fleet of 238 sailing and other barges.

Trustees for the debenture stockholders are The Right Hon. Lord Hillingdon and Sir Charles Rivers Wilson, G. C. M. G., President of the Grand Trunk railway of Canada.

Frederick Anthony White is chairman and W. Curling Anderson vice-chairman of the board of directors.

A new stucco plaster mill is to be erected at Oakfield, Genesee county, N. Y., by Geo. S. Emery of Boston, Mass.

The Colorado Portland Cement Co. of Florence, Col., is producing 300 barrels per day marketed principally in Colorado.

The Cumberland Hydraulic Cement Mfg. Co.'s Mill at Cumberland, Md., was destroyed by fire July 11, loss $75,000 not fully insured. John Ogelbag, test clerk, was overcome by heat and smoke, and Charles D. Ferguson, engineer, was burned about the hands and face while saving books from the office. The fire started while the workmen were at dinner. Dynamite exploded in the warehouse doing no special damage. Seven Baltimore & Ohio cars were destroyed. William Miser, contracting cooper, lost $1,000 worth of material. The entire mill was in ashes in one-half hour after the fire commenced. One hundred and forty-six men are thrown out of employment.

A CONCRETE AND EXPANDED METAL FIREPROOF VAULT.

We illustrate herewith a fireproof vault recently built for the Domestic Exchange National Bank of New York by the New York Expanded Metal Co. The bank occupies a portion of the third floor of the new fireproof building known as the "Broadway-Chambers," corner of Broadway and Chambers street, and a vault was desired that should be of sufficient fire-resisting quality to withstand any fire likely to arise in such a fireproof building, that should not be too heavy to be supported by the floor of the room, that should not waste too much room in thickness of its walls, and that should be reasonable in cost. Different vault builders proposed styles of vault which did not satisfy one or more of these requirements. These included vaults built of two thicknesses of boiler plate steel separated three or four inches, and the space filled with plaster and brick, and vaults of brickwork varying all the way from a single thickness of cellular fire-brick four inches thick up to solid brick walls two feet thick. A suggestion was made by Mr. William Kent that a suitable vault could be constructed of a combination of expanded metal and Portland cement concrete of the same kind as is used in fireproof flooring, viz.: the mixture of one part cement, two of sand, and four of coal ashes. This mixture in the tests made by the New York building department some two or three years ago showed remarkable resistance to fire and to heavy loads at the same time. The vault was constructed by the Expanded Metal Co., as shown in the accompanying illustration. The irregular outline at the rear is due to the presence of one of the supporting columns of the building. The door-jambs were made one foot eight inches deep, as shown, in order to accommodate an iron door casing, with double doors inside, which open and fall back against the jamb, and one large outer door. The doorway was roofed over with a slab three inches thick, made of concrete and expanded metal. The floor as well as the roof of the vault, was also made of concrete and expanded metal, the ordinary filling on top of the tile-brick being removed down to the level of the top of the floor girders and its place supplied by the concrete.

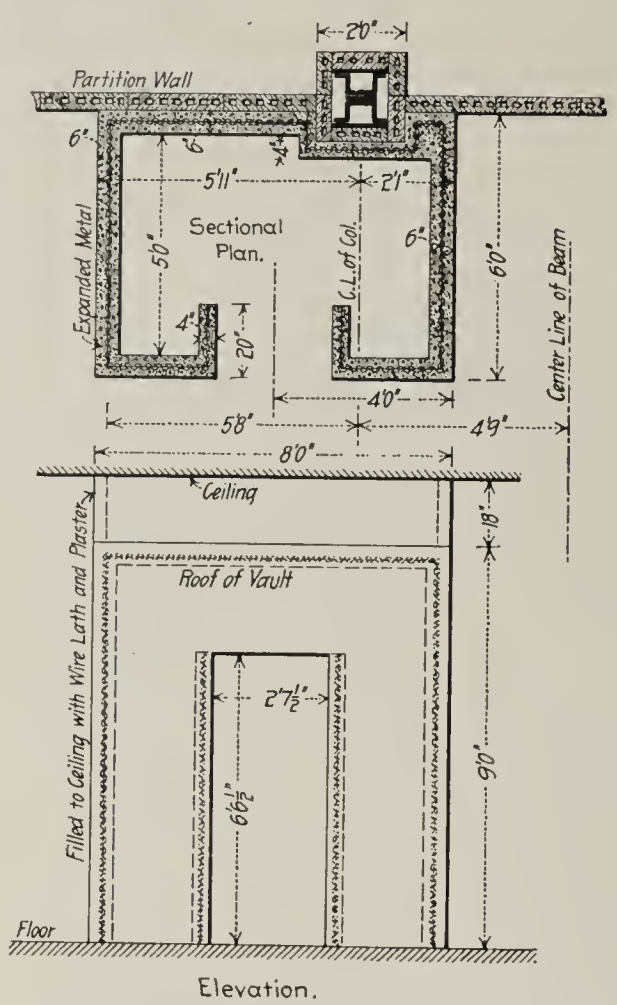


Fig. 1—Plan and Elevation of Fireproof Vault of Concrete and Expanded Metal.

In building the vault a structure of upright wooden posts of horizontal planks was built of the dimensions of the inside of the vault, then outside of this three inches away from the face of the planks, the sheets of expanded metal were hung, then an outer casing of planks six inches away from the inner casing was built as the filling in of the concrete proceeded. This was the plan followed by the building of the two side walls and the front. In building the rear walls the partition walls between the adjoining rooms formed one side of the mold for the concrete, and the inner planking, which was raised as the filling proceeded, formed the

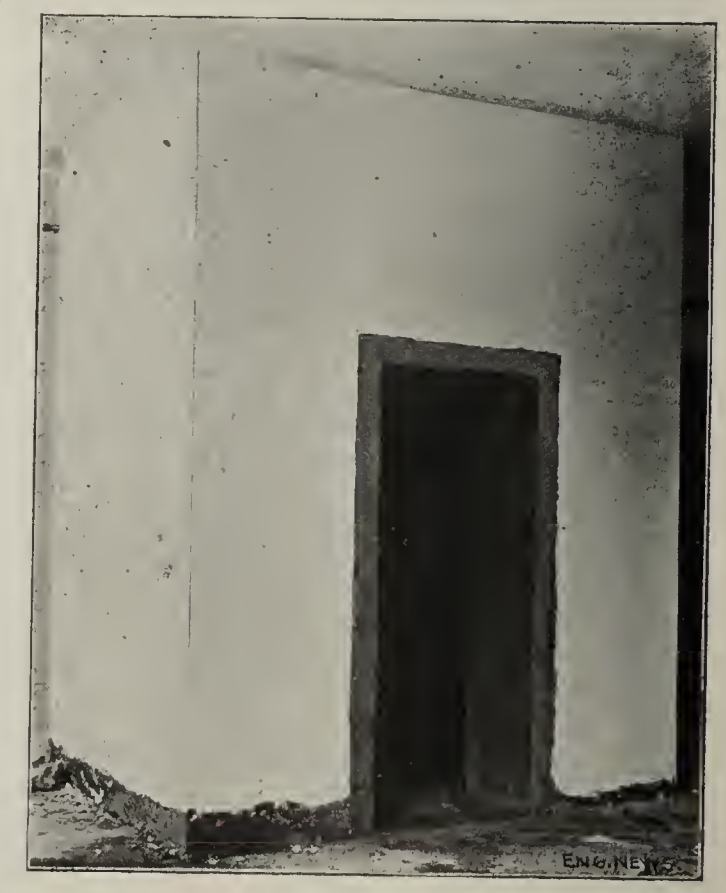


Fig. 2—General View of Vault Before Placing Door and Base Board.

other. The expanded metal used was a single sheet of three-inch mesh made of No. 10 steel. We are indebted to the New York Expanded Metal Co. for the drawing and photograph of the vault from which our illustrations are made. The photograph was taken before the insertion of the door casing, and the placing of a plaster baseboard around the bottom of the vault.—*Engineering News.*

A COMMUNICATION FROM THE ATLAS PORTLAND CEMENT COMPANY.

E. W. EVERSON, CONTRACTOR,
122 PUBLIC STREET,
PROVIDENCE, R. I., July 7, 1900.

ATLAS PORTLAND CEMENT CO.,
143 LIBERTY STREET,
NEW YORK.

GENTLEMEN:—I note in CEMENT AND ENGINEERING NEWS an article which surprises me, in that it states that I have bought 4,200 barrels of Haccourt cement for the dam at Tafftville, Conn., and that there has been rejected 5,000 barrels of Atlas.

The only thing that could give color to the story is the fact that we have in store at the Tafftville dam about three cars of Atlas cement in sacks that we carried over the winter and about which there is some question in the minds of the engineers in charge at the dam and also Mr. J. Herbert Shedd, consulting engineer.

We are glad to say that the cement which we are receiving from you is as far as reports from the work show up to this date very satisfactory, some briquettes 28 days old breaking over 900 pounds per square inch.

Yours very truly,
E. W. EVERSON.

P. S.—We have not used nor purchased for this or any other work in progress any other than Atlas Portland cement.
E. W. E.

CITY OF PROVIDENCE, }
COUNTY OF PROVIDENCE, } SS.
STATE OF RHODE ISLAND, }

In Providence, this 20th day of July, 1900, personally appeared before me E. W. Everson, known to me and known by me to be the person executing the instrument above and acknowledged the same by him signed and written to be a true and correct statement.

[SEAL] MILTON B. BROWN.
Notary Public.

CITY OF PROVIDENCE, }
COUNTY OF PROVIDENCE, } SS.
STATE OF RHODE ISLAND. }

Before me, this 21st day of July, 1900, personally appeared E. W. Everson, to me known and known to me to be the E. W. Everson who signed the above, who, being duly sworn, deposes and says that the above statement is true and correct in every particular.

Signed before me this 21st day of July, 1900.

[SEAL] MILTON B. BROWN.
Notary Public.

The above is designed as a refutation to an item in our last issue relating to Atlas cement. The notary seems to have accidentally omitted to procure Mr. E.'s signature, as he states, on July 21, at the time the oath was administered.

Sellersburg, Ind., is asking for bids on two miles of cement walk. Address R. F. Mix, clerk.

McKELVEY MIXER IN EVIDENCE.

GILSONITE ROOFING & PAVING CO.
ST. LOUIS, MO., July 6, 1900.

MCKELVEY CONCRETE MACHINERY CO.
CHICAGO, ILL.

GENTLEMEN:—Herewith enclosed please find check for the "McKelvey" hand-power mixer we bought of you some days ago.

Answering your inquiry as to how we like the mixer, we beg to state that we are well pleased with it. The first hour we operated it on sidewalk work, with two men turning the cranks and two shoveling into the mixing drum, we mixed enough concrete to lay 15 blocks, 6 feet by 6 feet by 4 inches. We also mixed large sized macadam stone to the entire satisfaction of the engineer in charge, at the St. Louis Transit Company's North Side power house, where we have contract for the entire concrete work.

The mixer saves us at least $10 per day, besides doing 50 per cent better mixing than is done by hand.

Wishing you the success that your excellent device merits, we are,

Very truly yours.
GILSONITE ROOFING & PAVING CO.
C. O. BRAINERD, Supt.

A cement plant is under consideration at Marksboro, N. J.

A Portland cement plant is to be erected in Marengo county, Ala.

Lakefield, Ont., will contribute 10,000 as a bonus for a cement plant.

The Birmingham Cement Co. of Ensley, Ala., is preparing to rebuild its plant.

Two natural cement mills near Charlestown, Clark county, Ind., have shut down.

Grass Lake, Barry county, Mich., has a Portland cement plant under consideration.

The Zenith Portland Cement Co. has been incorporated in Michigan. Capital $300,000.

There are sixteen Portland cement plants either constructed or under way in Michigan.

The Sun Portland Cement Co., Owen Sound, Ont., has been incorporated. Capital $500,000.

A beet sugar factory is projected at Iowa Falls, Iowa, capable of working beets from 5,000 acres of land. Beet sugar factories require large quantities of Portland cement in their construction.

The Egyptian Portland Cement Co. of Detroit has been incorporated with a capital of $1,050,000. Mr. G. A. Foster is president. A $300,000 plant will be erected at Silver Lake.

The works of the Aalborg Portland Cement Co. at Aalborg, Denmark, were destroyed by fire June 1, loss $160,000.

The Alpena Portland Cement Company is making changes in its plant on account of a change in the process of Portland cement manufacture.

Toronto, Ont., cement sidewalk tenders call for certified checks in the ratio of 2½ per cent on the contract price of the work in order to be entertained.

25,000 barrels of Mannheimer German Portland cement were rejected as not up to the standard by the United States naval authorities at Annapolis, Md.

The new Youghiogheny & Lehigh coal dock now under construction at Duluth, Minn., will have a cement floor. 200,000 tons of coal can be stored on this floor.

Incorporated: The South Bend Portland Cement Company. Capital $30,000. E. J. Darragh, John Stirlen, A. E. Stevens, John Raney and A. B. Shively, directors.

Incorporated: Standard Plaster Co., Camden, N. J., to deal in cement, lime, stone, etc. Capital $300,000. W. F. B. Stewart, C. C. Frick and G. H. B. Martin, directors.

The Portland cement market is rather slow for this season of the year. The high price of structural steel has a baneful influence on the demand for Portland cement.

The Jones Patent Plaster Co. has located at South Bend, Ind., having purchased the old Millan Portland Cement Works at that point and refitted the same for their special purpose.

Mr. R. G. Bush who for the past five years has been superintendent of the extensive plant of the Lawrence Cement Co. at Siegfried, Pa., severed his connection with this company on July 1st.

Incorporated: Rockland Cement Co., Newark, N. J., to deal in building materials. Capital $100,000. J. A. Degroat of Jones' Point; C. J. Curtin of Newark; S. A. VerValen of Haverstraw.

The marl deposits in and surrounding Lakes St. Joseph and St. Marys at Notre Dame, Ind., have been leased to a syndicate of South Bend, Ind. The marl will be used for the manufacture of cement.

The Birmingham Cement Company's mill at Ensley, Ala., was destroyed by fire on July 10th. Insurance $41,000, loss $100,000. The fire originated in the warehouse, the plant will be rebuilt at once.

California produced 60,000 barrels of Portland cement in 1899.

Fort Dodge, Iowa, has over $1,000,000 invested in the manufacture of stucco. Eighty square miles of gypsum rock exists in the immediate vicinity.

There are over seventy Portland cement plants in the United States, either in operation or under construction. Michigan and Pennsylvania show the greatest activity in development.

Incorporated: Atlas Artificial Stone Co., Brooklyn, N. Y., to deal in cement, concrete, etc. Capital $1,000. Mary J. Burke, W. Kniskern, both of Brooklyn, and Mary A. Sproule of Yonkers, directors.

The Union Lime Co. of Chicago has executed a trust deed on its extensive plant on Lincoln and West 18th streets to the Northern Trust Co. to secure an issue of $90,000 in bonds, maturing July 2, 1920, to refund outstanding obligations.

Estimates were asked for constructing a group of buildings for Alsen's American Portland Cement Works, to be located at West Camp, N. Y. The plans are by Architects and Engineers Lathbury & Spackman, 1619 Filbert street, Philadelphia, Pa.

The Hildeberg Cement Co. of Howes Cave, N. Y., is excavating cement rock from the natural cave at that point. Heretofore it has been a great attraction for pleasure seekers. A dam will be constructed across the caves mouth as a source of water supply for the plant.

Donald Sinclair of Kankakee, Ill., has contracted with the Illinois Central Railway for the erection of 24 concrete bridges between Effingham and Chicago. Two of the bridges have 40 feet spans between Mattoon and Effingham. Mr. Sinclair is using the McKelvey concrete mixer on the work.

A new tidewater level canal route across the Isthmus of Darien has been located by the United States commission charged with the investigation of the various routes across the isthmus. Sufficient facts have leaked out through the private correspondence of employes of the United States commission to designate the route from Caledonia Bay or Port Escosces on the Atlantic side, 130 miles east of the old Panama canal to the Gulf of San Miguel via the Savanna river. This identical route has several times been advocated and described in this journal by Thos. Wright Hurst, we shall describe this route in detail in our next issue by metes and bounds.

F. W. Melber, engineer and contractor of 531 Wood street, Pittsburg, Pa., has filed plans, specifications and prices with the city clerk of Grand Rapids, Mich., on his combined steel and cement sewer system. Great strength, durability and economy are the points claimed.

The imports of merchandise into the United States for 1899 was $697,148,489, of which $300,279,800 was free of duty and $396,868,697 dutiable. Our exports in 1899 were $1,227,023,302, of which $1,203,931,222 was domestic merchandise and $23,092,080 of foreign origin. The excess of exports over imports was $529,874,813.

The Reading Cement Co.'s new mill at Evansville, Pa., has just been completed and equipped with the latest improvements for making Portland cement and is now ready to start up at once. The several departments of the plant are in charge of competent and experienced experts. The office address of the company is 536 Penn street, Reading, Pa.

A large artificial building stone plant costing $120,000 has been erected at Cape May, N. J. The product will go to New York and Philadelphia. Only stock sizes of building stone will be manufactured from which architects can select for building purposes. The manufacture of artificial stone for building purposes is yet in its infancy in the United States, it must eventually displace natural stone where other than rough stone is to be used.

The Ohio Plaster Co. in control of the gypsum and plaster output in the vicinity of Grand Rapids, Mich., will cease to exist after August 1st. The following concerns constituted the combine: The Grand Rapids Plaster company, the Grand Rapids Gypsum works, F. Godfrey & Bro. and the Alabastine company. The immediate cause of the dissolution of the combine was the erection of the Midland plaster mill at Grand Rapids, which has secured contracts from the largest consumers for a year.

Incorporated: The Canadian Portland Cement Company as noted in our last issue will control the following plants: The Rathbun Cement Company of Nepanee and Marlbank, the Beaver Portland Cement Company of Marlbank and the St. Lawrence Cement Company of Montreal, Canada. The officers and directors of the new company are: President, E. W. Rathbun, Deseronto; managing director, F. G. B. Allan, Napanee Mills; James Dobson, Philadelphia; M. J. Haney, W. D. Matthews, B. B. Osler, C. A. Masten, Toronto; C. J. Webb, Philadelphia, directors.

A TREATISE
ON
Masonry Construction.
By Ira O. Baker, C. E.,
Professor Civil Engineering, University of Illinois; Member American Society of Civil Engineers; Member Western Society of Engineers, etc.

Six hundred and two and xv pp.; 160 figures, many of them full page; 6 folding plates; 97 tables of cost, strength, contents, etc. Copious index. The book contains the results of a great number of experiments and a large amount of practical data on the cost of masonry, pile-driving, foundations, culverts, etc., and also many tables of contents to facilitate the making of estimates. The data on cement testing, sand, gravel and broken stone, thoroughly covers the subject from a practical standpoint; all prepared especially for this volume. Also an appendix with standard specifications for all kinds of masonry for various purposes.

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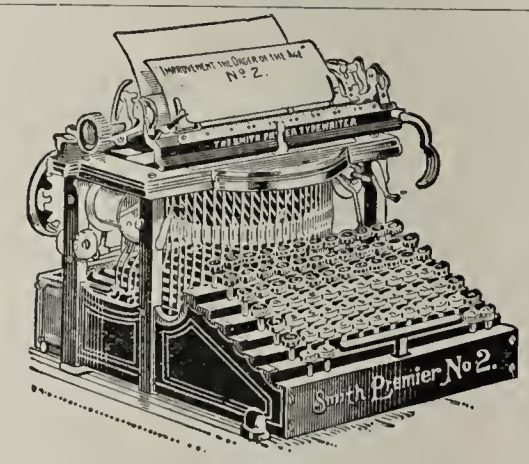

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GERMANY.

EXPORT OF CEMENT IN TONS.

TO	MAY.		JAN.-MAY.	
	1899	1900	1899	1900
Freeport, Hamburg	367	2,078	2,179	6,625
Belgium	934	405	2,549	1,906
Denmark	1,380	720	3,779	3,136
Great Britain	1,354	786	1,748	2,087
Holland	4,046	4,335	16,041	19,402
Norway	1,706	2,012	6,015	6,054
Austria	2,047	3,010	7,406	7,247
Russia	5,260	4,594	6,877	5,106
Finland	525	1,728	546	2,001
Switzerland	1,094	669	4,825	2,803
Cape Colony	95	1,127	2 154	2,696
Transvaal	218	340	3,801	595
China	24	33	10,968	3,432
Other East Indies	924	911	4,690	4,805
Argentine	18	51	4,638	6,040
Brazil	2,541	2,702	6,847	8,711
British North America	476	651	993	1,593
Chili	1,360	1,356	3,714	3,338
United States	25,238	34,301	81,458	112,085
Australasia	3,678	4,205	14,252	14,819
Totals, with others	53,956	60,149	194,209	232,386
1898	52,451	.....	183,247	.....
1897	48,119	.....	175,504	.....

BELGIUM.

EXPORT OF CEMENT IN TONS.

TO	APR.	JAN.-APRIL.		
	1900	1900	1899	1898
Germany	244	1.337	1 270	1.565
Great Britain	7,339	20.607	25,656	10,162
Australasia	410	514	4,566	1,253
Brazil	872	8,739	3,823	7,854
Canada	1,904	1,981	797	1,466
Cape Colony	188	1,067	953	1,739
Chili	46	194	246	644
China	221	1,438	1,450	3,021
Cuba and Porto Rica	256	1,931	1,547	183
Egypt	1,037	4,607	3,248	1,436
Spain	726	2,166	1,765	1,450
Congo Free State	11	353	327	132
United States	13,406	34,501	26,848	31,309
France	1,526	4,300	3,127	2,895
British East Indies	964	2,217	3,194	2,260
Japan	.....	12	382	3,008
Mexico	299	2,105	1,748	385
Natal	161	162	2,876	413
Norway	613	2,008	2,403	1,008
Holland	5,280	14,273	12,045	12,113
Portugal	454	1,915	1,156	1,205
Argentine	2,797	10,890	12,127	10,215
Roumania	86	105	891	266
Russia	15	17	458	507
Turkey	.....	42	171	33
Uruguay	.....	61	248	72
All others	762	4,168	4,441	3,371
Total (kils.)	.....	121718	117,777	100,031
April only	39,635	.....	46,377	27,072
Full years	.....	.....	449,936	419,131

ENGLAND.

CEMENT SHIPPED FROM PORT OF LONDON, June, 1900.

TO	TONS	TO	TONS
Adelaide	89	Las Palmas	25
Alexandria	7,402	Lisbon	60
Algoa Bay	36	Lyttleton	296
Amsterdam	215	Madras	143
Antwerp	238	Malta	9
Auckland	143	Melbourne	303
Baltimore	89	Mornbassa	9
Beunos Ayres	1,462	Montevideo	984
Bahia	12	Montreal	1,376
Barbadoes	163	Mossel Bay	107
Boca	39	Nelson	36
Bombay	115	Newport News	180
Brisbane	223	New York	144
Calcutta	483	Odessa	48
Capetown	773	Ostend	42
Channel Isles	328	Paysandu	61
Christchurch	9	Penang	535
Cologne	16	Pt. Elizabeth	51
Colombo	1,489	Rangoon	289
Constantinople	18	Reval	5
Demerara	89	Rotterdam	254
Durban	1,295	San Francisco	1,960
East London	828	Singapore	105
Flushing	40	St. Helena	38
Fremantle	956	St. John, N. B	111
Ghent	9	St. Lucia	108
Gibraltar	3,419	Surinam	36
Grenada	68	Sydney	1,690
Groeningen	15	Tumaru	125
Halifax	1,150	Trinidad	548
Hamburg	8	Valencia	223
Harlingen	40	Valparaiso	4 535
Havanah	44	Vancouver	193
Hongkong	5	Vera Cruz	756
Huelva	45	Victoria, B. C	71
Honfleur	80	Wellington	302
Jamaica	345	Yokohama	54
Kingston	178		

UNITED KINGDOM.

EXPORT OF CEMENT IN TONS.

TO	MAY.		JAN.-MAY.	
	1899	1900	1899	1900
Holland	530	347	1,727	1,726
United States	1,872	4,617	7,453	24,120
Brazil	1,474	889	5,972	5,176
Argentine Republic	1,019	1,692	6,862	7,441
British South Africa	3,384	6,952	15,368	18,790
British East Indies	3,962	5,153	21,094	21,718
Australasia	4,426	1,895	14,723	11,117
Canada	2,345	7,194	4,503	10,682
All others	17,401	20,276	59,796	71,889
Totals	36,403	49,015	137,498	172,659

Exports of cement for May, 1898, were 25,955 tons; from January to May, 1898, 140,294 tons.

CEMENT IMPORTED INTO THE UNITED KINGDOM.

From December 1, 1899 to February 27, 1900.

FROM	TO	TONS.	£
Antwerp	Liverpool	140	300
"	"	32	70
"	"	100	158
"	Bristol	14	23
"	"	11	20
"	"	178	103
"	Cardiff	202	302
"	"	49	74
"	Goole	115	220
"	"	60	114
"	"	49	93
"	Grimsby	10	100
"	Manchester	50	75
"	"	10	15
"	Middlesboro	100	200
"	Newcastle	13	26
"	Preston	215	322
"	Southampton	44	66
"	Sunderland	336	671
"	Douglas	133	200
"	Glasgow	170	499
"	"	435	1,306
"	"	327	981
"	"	255	766
"	Grangemouth	236	420
"	"	256	475
"	Belfast	130	195
"	Dublin	30	60
"	"	50	73
"	Ramsey	88	101
Brussels	London	50	70
"	"	86	130
"	"	67	101
Boulogne	Cardiff	51	76
Copenhagen	London	5	10
Ghent	"	50	90
"	Liverpool	95	210
"	Goole	10	19
"	"	10	19
"	Hull	80	405
"	"	219	870
"	"	86	340
"	"	110	330
"	Manchester	177	244
"	"	51	75
"	"	59	89
"	Newcastle	53	105
"	Sunderland	250	500
"	Ayr	732	1,038
"	Leith	100	125
"	"	150	187
Hamburg	Dundee	100	325
Nieuport	Ramsgate	90	135
Rouen	London	90	270
Rotterdam	Aberdeen	300	600
Stettin	Manchester	50	69
Temeuzen	Teigmouth	125	239

UNITED KINGDOM.

EXPORT OF CEMENT IN TONS, APRIL, 1900.

TO	TONS	TO	TONS
Albany	1,296	Larnaca	10
Alexandria	4,154	Lisbon	179
Amsterdam	512	Lyttleton	330
Auckland	134	Madras	45
Buenos Ayres	1,578	Malta	146
Bahia	184	Mauritius	83
Barbadoes	146	Melbourne	259
Bermudas	27	Montreal	298
Bluff Harbour	27	Nagaski	248
Bombay	418	Napier	45
Boston	13	Nelson	98
Brisbane	178	Newcastle, N. S. W.	178
Baltimore	54	New Orleans	89
Calcutta	517	Newport News	501
Canada	35	New York	171
Capetown	1,204	Odessa	32
Channel Isles	302	Otago	54
Chinde	6	Penang	38
Cologne	7	Port Elizabeth	1,580
Colombo	549	Rangoon	623
Constantinople	36	Rockhampton	54
Demerara	411	Rotterdam	224
Durban	464	Rouen	50
East London	173	San Francisco	2,841
Galatz	20	San Diego	3,576
Gibraltar	2,500	Santos	268
Gothenburg	4	St. John, N. B.	33
Halifax	218	St. John, N. F	154
Hamburg	210	St. Lucia	18
Harlingen	27	Sydney	833
Havana	689	Trinidad	439
Hobart	87	Vancouver Isle	84
Hongkong	5	Vera Cruz	331
Jamaica	347	Vladivostock	379
Kumachee	44	Wellington	143
La Guayra	15		

IMPORT OF CEMENT INTO UNITED KINGDOM, 1900.

MONTHS.	TONS.	VALUE £
January	3,934	8,082
February	7,018	14,857
March	5,401	12,213
April	7,918	17,694
May	9.820	21,115

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

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IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	MAY.				ELEVEN MONTHS ENDING MAY.			
	1899.		1900.		1899.		1900	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom	840,000	3,254	3,196,610	12,242	98,228,130	359,310	91,906,900	362,838
Belgium	11,337 689	31,174	19,518,360	63,374	228,541,122	690,227	259,903,620	752,701
France	1,641,200	4,926	297,600	1,277	7,060,000	21,755	6,182,997	23,946
Germany	38,517,746	135,811	58,145,364	201,122	384,342,669	1,327,788	450,367,874	1,657,113
All Other Europe	1,075,000	4,059	1,988,522	6,451	19,319,787	45,603	25,338,062	80,748
British North Am.	105,000	493	280,300	1,638	1,254,145	5,748	1,253,890	6,855
Other Countries	.....	.....	480,000	2,034	2,000	9	4,583,160	21,407
TOTAL	53,516,635	179,717	83,906,756	288,138	738,747,853	2,450,440	839,536,503	2,905,608
Domestic Exports of Cements, bbls.	9,144	17,215	7,976	16,775	59,564	121,218	70,091	149,968

There were 1,190,138 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on May 31, 1899, valued at $3,759, against 7,712,742 lbs., valued at $26,584 in May, 1900.

Imports of asphaltum or bitumen for May, 1899, were 10,387 tons valued at $47,578; May, 1900—10,296 tons valued at $40,888. For eleven months ending May, 1899, 59,876 tons valued at $202,340; for eleven months ending May, 1900—97,644 tons valued at $320,160.

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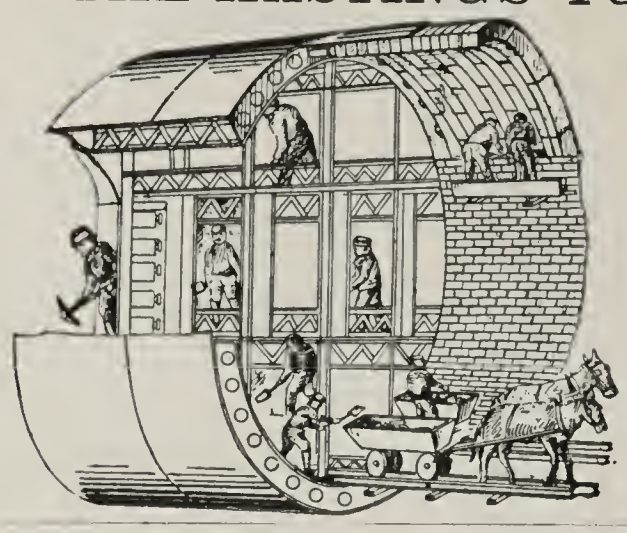

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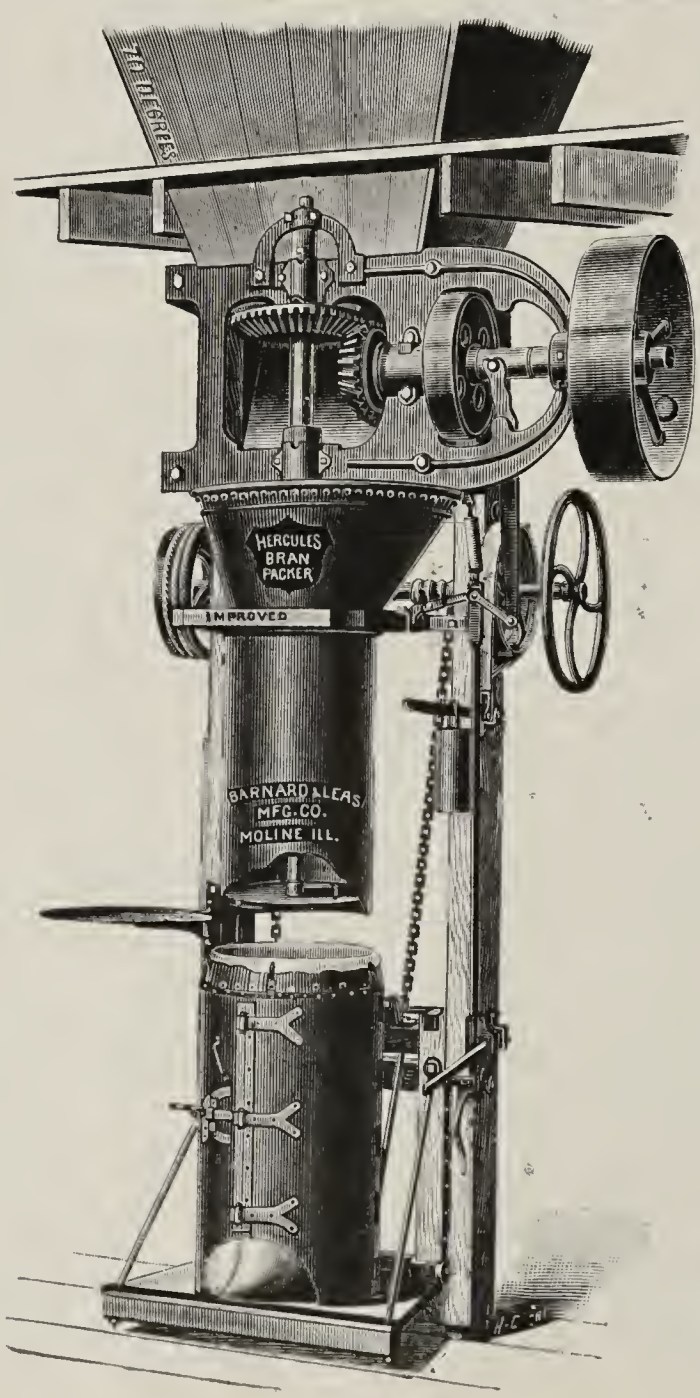

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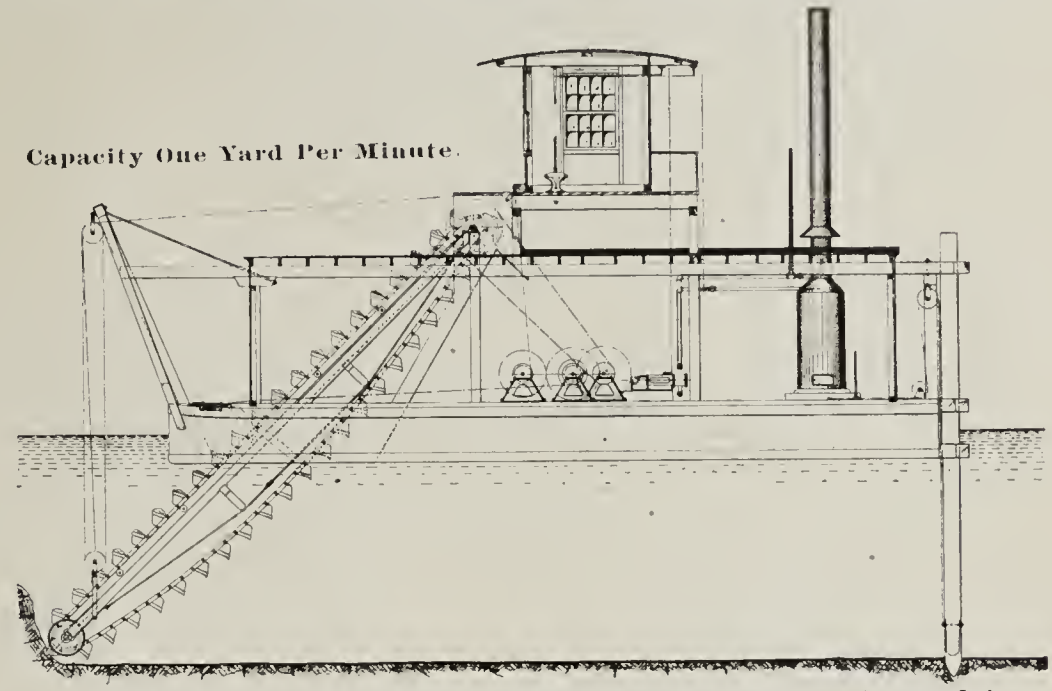

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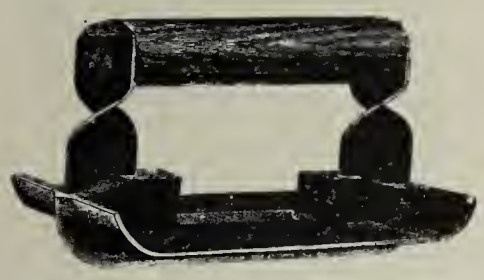

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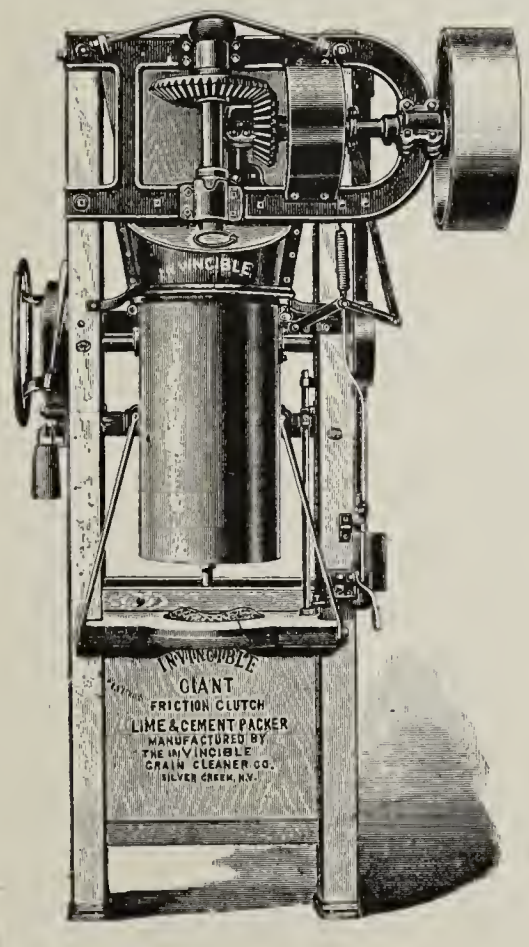

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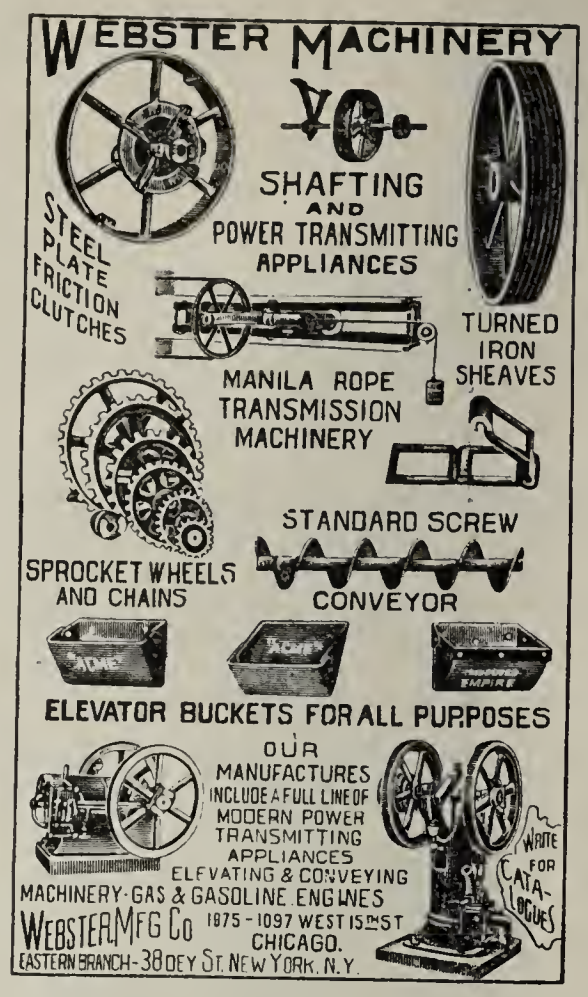

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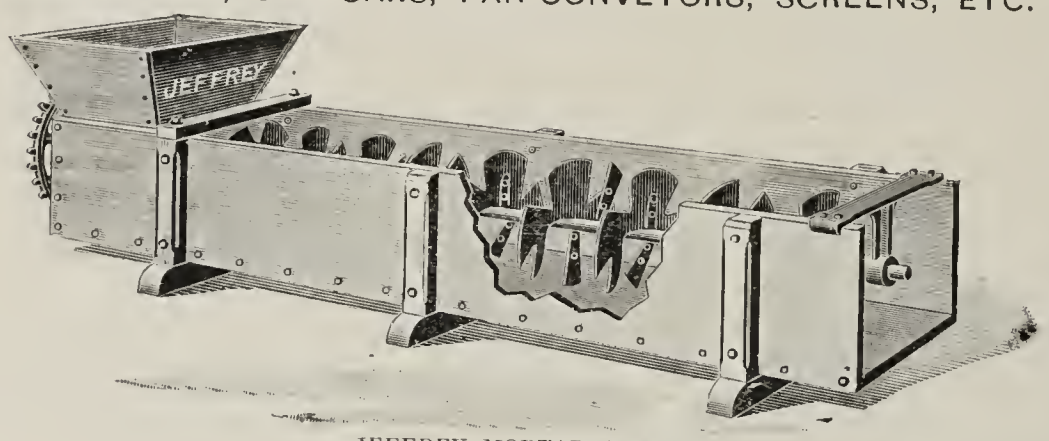

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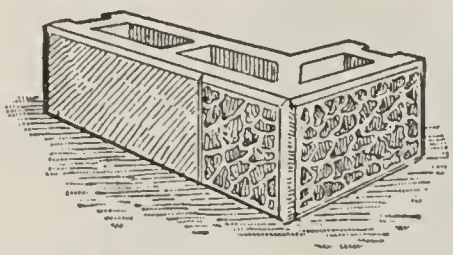

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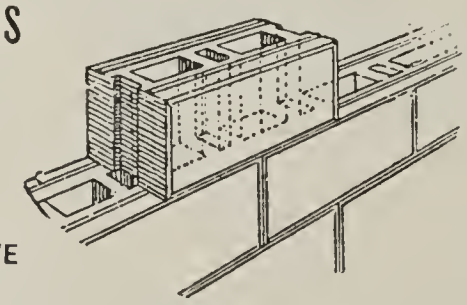

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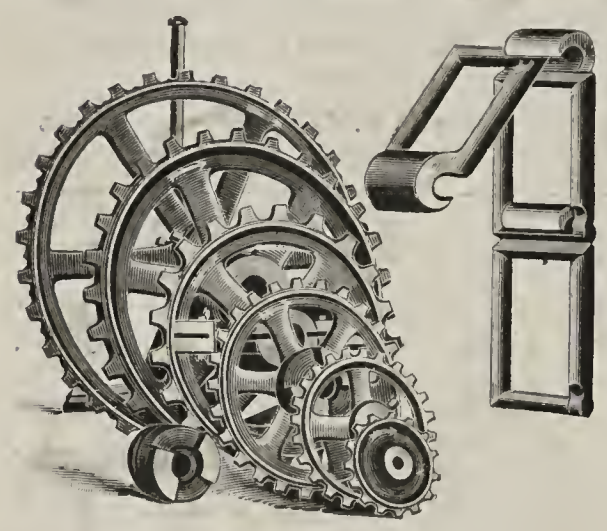

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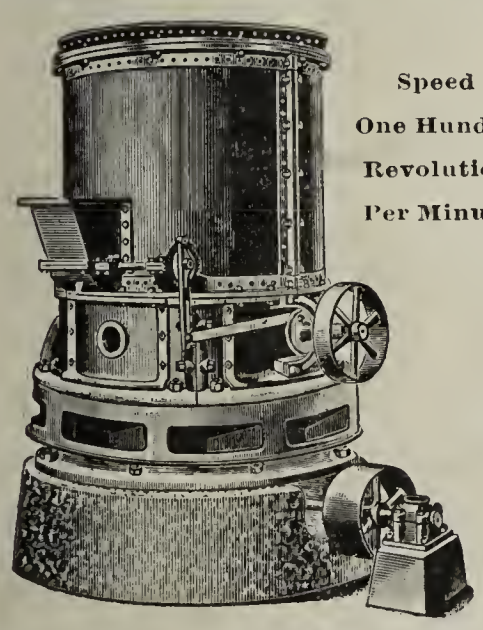

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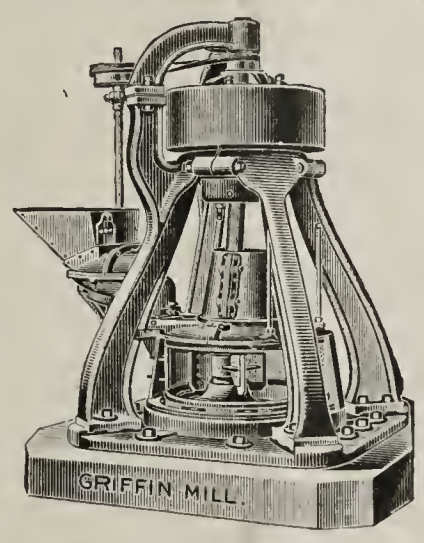

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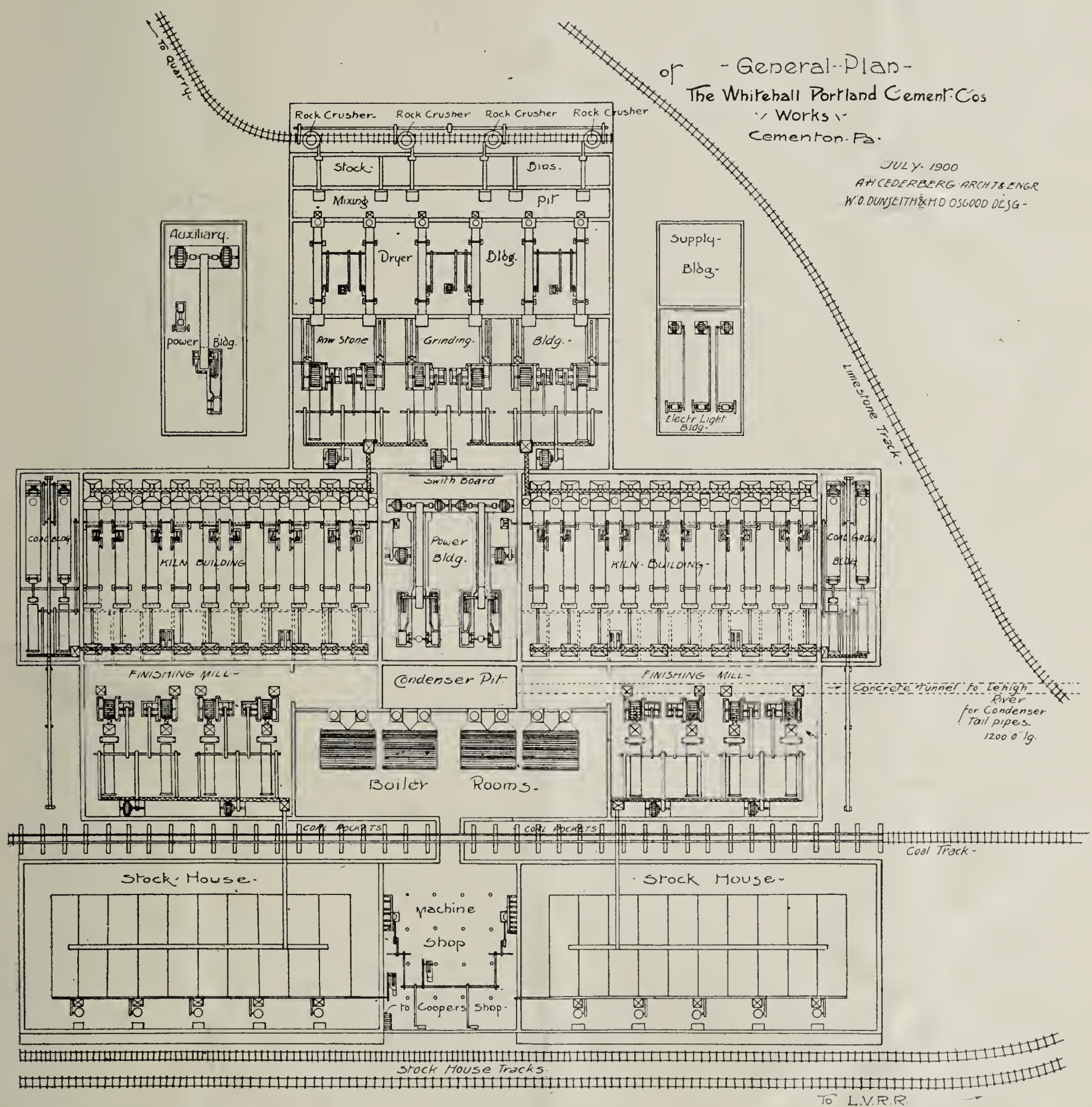

For descriptive article see pages 23–27.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

CEMENT PRICES DECLINE.

There has been a sharp decline in the price of Portland cement during July and August due to the slack demand and consequent accumulating stock in mills of the Lehigh regions. The storage capacity being limited, large quantities are being shipped west and stored at convenient distributing points, otherwise the mills would either be compelled to shut down or greatly increase their storage capacity.

To the consumer in the West the fall in price comes as a surprise, like a flash of lightning from a clear sky, without warning or apparent cause. For the past two years the domestic Portland cement industry has been overtaxed with orders far in excess of the capacity of the mills to supply, at the same time we imported about 2,000,000 barrels per year. This enabled our mills to dictate high prices and thus recoup for a long previous period of depression, during which American Portland cement was under the ban of prejudice. This era of high prices stimulated production, old mills were enlarged, new mills were projected and built. In the State of Michigan alone fifteen new plants have been erected or are under way, not counting the numerous hazy projects under consideration. There are fully eighty plants in being or under way, in the United States and Canada, that will in the near future compete for trade in the two countries. The present decline in prices must be regarded as legitimate and based upon the law of supply and demand.

Cement has been sold in New York City at $1.68½ in 1,000 barrel lots and in Chicago at $1.87. There is every assurance that present prices will be maintained for the remainder of the season. We look for a brisk trade from now on. The heavy cut in structural steel and the passing of labor troubles will revive numerous building and engineering projects and thus increase demands for the available cement supply.

The effect of the decline in price of domestic Portland upon imports is uncertain, by consulting our tables giving the movement of European cement it will be seen that there is still a considerable import and export traffic of cement between England, Germany and Belgium, notwithstanding that each country named is a large producer. It is therefore reasonable to assume that the high grade European cements will still find a market in the United States especially along the Atlantic coast line. Rates from German ports have already been cut to this country, while another project has been canvassed to ship in bulk from the German mills to American ports and repack here for distribution after American methods.

40,000 barrels of Portland cement will be used in the new bridge over the St. Lawrence river at Quebec, Canada. M. P. Davis, contractor for sub-structure.

Westerly, R. I., has been laying macadam roads of crushed granite and granite dust and find that this material does not wear as well as crushed blue stone.

The New York City Dock Board yesterday awarded a contract for supplying 1,000 barrels of cement to John J. Kane & Co., at $1.68½ a barrel. Kane is a Tammany man.

CITY ENGINEER ERICSON FAVORS CONCRETE.

City Engineer Ericson of Chicago favors concrete in place of brick for all underground work. He says:

"Recent tests of concrete for underground work have proved it to be superior to brick both in cost of labor and material and in its durability. It is, therefore, very probable the next year will see a much more extensive use of this material than in the past. Under such conditions some check is necessary in the use of cement. In the East concrete tunnel work is fast gaining favor, and though there is little construction of that character to be done in Chicago for a time it is likely it will be of concrete material rather than brick."

"With the use of concrete increasing, some method of requiring the best grade of cement in sufficient quantity is imperative. Contractors have heretofore purchased the cement and used as little of it as they could when the city inspectors were not looking. If the city purchases it for contractors the cause for using too little of it will be removed and the departments can be sure of its quality. There is complaint against cement used in almost every contract, and the failure of concrete bears out in many cases the accusation. Concrete work is bound to be more extensive. It costs Chicago $8 a day for tunnel bricklayers, while concrete tampers can be obtained for $2 a day. The original cost of brick is greater. I believe from 30 to 40 per cent in cost can be saved by use of concrete, and if it is adopted the check on quality and quantity of cement must be adopted."

City Engineer Ericson's views are sound. The bricklayers and brick manufacturers of Chicago are a potent aggressive force, all acting as a unit against the use of concrete. Nothing will satisfy them other than the building of a perishable monument of brick in honor of their craft, in the form of sewers and tunnels at the expense of the city treasury.—ED.

Sellersburg, Ind., will lay cement walks.

The Potomac Hydraulic Cement Works near Cumberland, Md., were destroyed by fire Aug. 18.

The City of Minneapolis has passed 48 ordinances for cement sidewalks 6 feet to 8 feet wide covering one or more blocks each. L. A. Lydiard, city clerk.

The National Asphalt Company has filed an amended certificate with the secretary of state of New Jersey increasing its capital stock from $15,000,000 to $22,000,000.

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HOW TO CALCULATE THE PROPER CEMENT RAW MIXTURE FROM THE GIVEN RAW MATERIALS.

BY DR. W. MICHAELIS, JR.

About thirty years ago, when cement chemistry was not yet far enough advanced and Portland cement was manufactured in Europe by burning clay and chalk in proportions, which had first to be ascertained for every special material, until satisfactory results were obtained, Dr. W. Michaelis, senior, of Berlin, assumed the task to analyze the most celebrated cements of those days with a view to study the constitution of hydraulic mortars and if possible to formulate certain rules, which might be proper to all cements. . This would enable him to predict in advance the proper proportions in which the raw materials must be mixed and the determination of the proper cement raw mixture would no longer be the result of tedious test burns in the most various proportions, until by chance the right mixture was obtained.

The results of Dr. Michaelis' laboratory work demonstrated the fact, that the quantities of the principal compounds, which build up cement, differ only very little in the best cements and that a certain ratio exists between the quantity of lime and the quantity of silicates ($SiO_2+Al_2O_3+Fe_2O_3$). This ratio, the so-called "Hydraulic Modulus" or "Coefficient of Hydraulicity" was found to be in an average 2:1, that is to say, 2 parts by weight of lime are present for 1 part by weight of silica plus alumina plus iron oxide. All of the best cements differed only slightly from this figure.

The next step in the investigation was to build up cements by mixing chalk and clay in the most various proportions in order to determine how far it is allowable to remain under this figure and how far it may be surpassed.

Experience very soon taught that the hydraulic modulus is a very limited figure and therefore it is permissible to deviate from it only very little. A deviation of a few tenths of a decimal from the figure 2 above and below proves to be injurious to the finished product and cement can be burnt with safety only, if the hydraulic modulus lies between the figures 1.8 and 2.2. All raw mixtures with a modulus lower than 1.8 are too rich in silica and yield a cement, which disintegrates while cooling. On the other hand, if the lime is carried so high, that the hydraulic modulus surpasses the figure 2.2, the mixture contains too much lime, a part of which does not go into chemical combination in the burning process. In this case the finished product is injured by free lime, which slakes after the hardening of the mortar has begun and so forms the cause of cracking or swelling.

There are certain cases, where the content of lime may be carried higher, but these refer to special conditions, which are not obtained in daily practice. Some natural cement rocks contain carbonate of lime and clayey substance in a so perfectly mixed state, that there is no danger that the whole of the lime does not go into chemical combination in the fluxing even when the hydraulic modulus is as high as 2.4. Another case, where it is allowable to adopt this modulus 2.4 or even 2.5, without risk of injure, exists if the raw mixture is burnt at so high a temperature, that it is not only vitrified but completely fused. In this case the perfect mixing and combination of the raw materials is secured in the liquid fusing mass. Both cases are so extraordinary that they can be obtained only in laboratory test burns, and must be considered beyond the reach of actual practice. Therefore we are confined to a hydraulic modulus from 1.8 to 2.2.

With the proof of the fact, that this ratio must exist in all cements, a valuable middle was given for the calculation of the proper cement raw mixture. In order to be sure, that the finished product is neither too high in lime nor too high in silica, the average figure 2 was adopted for the hydraulic modulus in the calculating of the raw mixture and this proved to be satisfactory for all kinds of raw materials suitable for cement making. The fact is now so universally acknowledged, that in all countries, where severe specifications are given to the manufacturer of Portland cement, the standard rules adopted the hydraulic modulus as being between the figures 1.8 and 2.2

Later Mr. Le Chatelier studied the constitution of hydraulic mortars and succeeded in building up by synthesis various compounds out of silica, alumina, lime and iron. A careful comparison of these compounds with those found in cement enabled him to give approximately the composition of the vitrified clinker. On the basis of the ascertained compounds he gave his experience the shape of formulas, in which the proportions of the substances are given in equivalents:

$$\frac{CaO,\ MgO}{SiO_2-(Al_2O_3,\ Fe_2O_3)}>3 \text{ and } \frac{CaO,\ MgO}{SiO_2+Al_2O_3}<3$$

This is again a statement of the fact that lime and silicates must exist in a certain limited ratio, only the experience was now enclosed in a more scientific shape. All cements, the analyses of which show their principal compounds proportioned like these formulas demand, answer at the same time the demand of a hydraulic modulus between 1.8 and 2.2.

Recently American cement chemists tried to repeat Le Chatelier's experiments. Unfortunately they worked under quite different conditions, at a far higher temperature and leaving out of view the fact that at different temperatures different compounds out of silica, lime and alumina may be formed. Therefore the results of these experiments are without use for practice. Le Chatelier's formula gave the limits of the proportions on both sides as sure as they are asked for by the limits of the hydraulic modulus 1.8 to 2.2. The new American formula, worked out at a temperature where higher limed cements can easily be obtained, yields in practical application cements with a too high hydraulic modulus, it is without use because one-sided.

The present state is, that American chemists find only little advice on this subject in a few articles, which treat of special cases, for instance, how chalk must be mixed with clay which contains no lime, etc. Such advices offer only little help. Everyone must be able to figure out a proper cement raw mixture from all kinds of raw materials, equally with impure chalk (marl) and clay or with pure raw materials. I therefore recommend the calculation of the proper cement raw mixture on the basis of the hydraulic modulus 2, which I will develop hereafter for all kinds of raw materials. In doing this I am sure to offer a welcome assistance to many cement chemists in this country, as it happened often on my visits to American cement works, that the chemists showed me the analyses of the raw materials and asked me what the proper raw mixture would be?

A general contemplation in abstract figures will teach us how to combine any kind of raw materials in order to obtain a cement with a hydraulic modulus whatever desired.

The analysis of the dried Chalk, Marl or Limestone, yields:

l_1% lime and s_1% silicates [$SiO_2+Al_2O_3+Fe_2O_3$]

and that of the dried Shale or Clay:

l_2% lime s_2% silicates [$SiO_2+Al_2O_3+Fe_2O_3$]

The hydraulic modulus may be represented by the figure x.

Then s_1 parts of silicates in the Limestone require $x \times s_1$ parts of lime, so that only $l_1 - x \times s_1$ parts of lime of the Limestone are free for the Clay.

On the other hand the l_2 parts of lime in the Clay require $\frac{l_2}{x}$ parts of silicates, which must be deduced from the s_2 parts; hence $s_2 - \frac{l_2}{x}$ silicates remain for combination with Limestone.

Therefore $s_2 - \frac{l_2}{x}$ indicate the quantity of Limestone required by the Clay and $l_1 - x \times s_1$ the quantity of Clay required by the Limestone. The first must be multiplied by x, the modulus asked for.

$$\text{Hence } \frac{\text{Limestone}}{\text{Clay}} = \frac{x \times \left(s_2 - \frac{l_2}{x}\right)}{l_1 - x \times s_1} \text{ or}$$

$$\frac{\text{Limestone}}{\text{Clay}} = \frac{x \times s_2 - l_2}{l_1 - x \times s_1}$$

The following example, where clay and chalk are the raw materials may illustrate the use of the above formula:

ANALYSIS OF CHALK.

Silica equals	2.5 %	
Alumina "	1.4 %	=5.0%
Iron Oxide "	1.1 %	
Magnesia "	0.2 %	
Lime "	**53.0** %	
Carbonic Acid =	41.8 %	
	100.00%	

ANALYSIS OF CLAY.

Silica equals	55.7 %	
Alumina "	17.2 %	=81.2%
Iron Oxide "	8.3 %	
Lime "	**1.4** %	
Magnesia "	2.4 %	
Sulphuric Acid "	1.6 %	
Alkalis "	3.3 %	
Loss on Ignition "	10.1 %	
	100.00 %	

We have now to replace in the above formula the letters by the respective figures:

l_1	equals 53.0	equals	lime in the Chalk
s_1	" 5.0	"	silicates in the Chalk
l_2	" 1.4	"	lime in the Clay
s_2	" 81.2	"	silicates in the Clay
x	" 2	"	given hydraulic modulus.

$$\frac{\text{Limestone}}{\text{Clay}} = \frac{2 \times 81.2 - 1.4}{53 - 2 \times 5} = \frac{161}{43} = \frac{3.8}{1}$$

or 3.8 parts of chalk plus 1 part of clay will yield a proper cement raw mixture from these given raw materials.

The following calculation serves to control the hydraulic modulus:

	LIME	SILICATES
1 part of clay	1.4	81.2
3.8 parts of chalk	201.4	19.0
	202.8	100.2
hydraulic modulus	2.02 :	1

Now the result of the analysis can be predicted at once:

	Silica.	Alumina.	Iron Oxide.	Lime.	Magnesia	Sulphuric Acid.	Alkalis.	
1 clay	55.7	17.2	8.3	1.4	2.4	1.6	3.3	
3.8 chalk	9.5	5.3	4.2	201.4	0.8	—	—	
Total	65.2	22.5	12.5	202.8	3.2	1.6	3.3	=**311.1** parts

These figures divided by 3.111 yield the percentage of the Finished Cement:

Silica	equals	21.0%
Alumina	"	7.2%
Iron Oxide	"	4.0%
Lime	"	65.2%
Magnesia	"	1.0%
Sulphuric Acid	=	0.5%
Alkalis	equals	1.0%
		99.9%

$$\text{Hydraulic Modulus} = \frac{65.2}{32.2} = \mathbf{2.02}$$

In practice the analysis of the finished cement will always differ a little from the calculated composition, because the ashes of the fuel produce a slight change in the composition of the cement. As these ashes have a greater percentage of silicates than the cement, the finished product will be richer in silicates than calculated. In our case the content of silica would probably be increased about one per cent and the percentage of lime decreased at the same time. Both are of advantage in this special case.

After the raw materials are mixed in the proper proportions according to the result of this calculation a carbonate of lime test should be made in order to ascertain whether or not the materials are thoroughly mixed. In our case this test will yield 75 per cent carbonate of lime.

A test burn on a small scale with a few pounds of the mixture yields the best proof of the qualities of the raw materials. For this purpose little balls are formed out of the moistened mixture, which are afterwards dried and burnt in a test kiln with charcoal or coke. Half an hour from the time, when a good fire is obtained, is sufficient to vitrify the material; a too long burning injures the cement. The cooling must be done quickly and the vitrified balls must be cleaned with a sharp knife from the slags of the fuel, which adhere to them. The cement is then ground sufficiently fine, so that 75 per cent pass a 200 mesh sieve and the ordinary physical tests are made on setting, hardening and constancy of volume.

This method of calculating the proper cement raw mixture will be found to yield trustworthy results and anyone may easily see for himself that, by changing the hydraulic modulus, even a slight deviation from the average figure 2 proves to be injurious to the finished product.

The Bonneville Portland Cement Co. of Siegfried, Pa., has given a $300,000 mortgage to the Equitable Trust Co. of Philadelphia.

The Decarbonated Lime and Stone Co. of Chambersburg, Pa., has been organized at Waynesboro with a capital of $12,500, by J. W. Warehime, Reuben Shover, T. H. West, J. A. Stoner, W. T. Omwake, J. F. Zullinger and Simon Wiener.

St. Louis, Mo., cement and granitoid workers struck for higher wages. Foremen, 45 cents an hour; finishers and frame setters, 37½ cents; blockmen, 28½ cents; mixers, 25 cents; eight hours to constitute a day; every hour overtime to be paid for at the rate of an hour and a half; double pay for Sunday work. The contractors conceded the scale except so far as it applied to mixers, as that they are not in any sense skilled laborers, and that 20 cents an hour, or $1.60 a day, are fair wage for them. There are 100 contractors in St. Louis engaged in granitoid work; of this number all but twenty-one have agreed to pay the scale, and the twenty-one agree to pay union wages to all engaged in the craft except the mixers.

The city of Sioux City pavements are being delayed by the contractors' failure to procure cement for foundations.

The south canal pier at Duluth, Minn., now under construction is being done in blocks of concrete weighing 100 tons each, laid in alternate sections. The space between the alternate blocks are yet too be filled in.

Consignments of foreign Portland cement received at San Francisco for the week ending August 11 have been as follows:

	Barrels.
City of Benares, London	12,421
J. W. Wendt, Hamburg	19,000
Endora, London	15,915
Alsternixie, Hamburg	25,743
King George, Antwerp	10,568
Milverton, Antwerp	17,089
Total	100,736

This is the largest amount of cement received at this port in any five consecutive days. Other vessels due from Europe have considerable consignments of the same material.

THE WHITEHALL PORTLAND CEMENT COMPANY'S WORKS AT CEMENTON, PA.

By A. Hugo Cederberg,
Designer and Constructor, Catasauqua, Pa.

Among the more modern cement plants erected during the last year in the Lehigh Valley cement region, the Whitehall Portland Cement Company's new mill is conspicuous in its new arrangement and grouping of its various buildings. There are up to date very few cement works where the run of the material advances during the process of its manufacturing on a "straight line." We very often find thousands of feet of conveyors used to convey the material from building to building without apparent reason, showing that the planning of the buildings has not been in harmony with the economic run of the material. We often find the stock house close up to the crusher building. Again we find material has to cross one or two and sometimes three buildings before going through any process of manufacture. Why these facts have been so conspicuous is to the writer a more or less mystery. This involves an unnecessary expense in machinery and use of power, and adding that much more to possible delays and accidents, which as we all know are something enormous in cement mills. The plan of the mill shows that the material travels practically only one way, namely, right forward, never crossing or recrossing any buildings where it has previously been treated. In constructing this plant the writer's aim has been to do away as much as possible with all surplus conveying apparatus. The extent of the ground, on which the mill is built, did not give the writer the opportunity to accomplish said idea in its most proper form and the nearest practical result is as shown on plan.

The property of the company comprises about 67 acres at Cementon, Pa., on the main line of the Lehigh Valley railroad, two minutes walk from the Cementon station. The map shows the immediate site of the plant, which is located on a flat of about 11 acres directly adjacent to the railroad.

The quarry is on the opposite side of the street and is connected with the mill site by a small strip of land. The material is ordinary Lehigh Valley cement rock, practically the same in quality as found in the other cement works quarries. Drillings were made under Mr. E. D'Invillier, and in several places to the depth of 200 feet, showing that merchantable Portland cement could be manufactured at same cost as in other cement mills. No limestone of any importance is to be found on the property. The analyses of the cement rock were made under the supervision of Booth, Garrett and Blair of Philadelphia and checked by two other analytical chemists. The quantity of alumina and silica was satisfactory, carbonate of lime varied from 59 up to 76; carbonate of magnesia from 1.79 to 4.70. Stripping of quarry was commenced on September 9, 1899, and has been worked on continuously ever since. On the same date the construction of the plant was started. No contract work has been done in this undertaking. The company under the writer's supervision and control having done all their own work with their own men throughout.

OFFICE AND LABORATORY WHITEHALL PORTLAND CEMENT COMPANY.

The first buildings to be erected were the barracks to house men for ordinary labor, and the machine shop in which was installed lathes, boring machines, forges, shapers, bolt cutters, planers, hack saws, etc., etc.

The several buildings comprising the plant are as follows:

1st. Crusher building—This building is of wood (yellow pine timber and hemlock sheeting covered with No. 22 clapboard sheet iron). Said building is connected to the quarry by trestle 38 feet above ground. Four McCully crushers No. 4 are placed in this building. Each crusher resting on a set of concrete piers 29 feet above ground level; said piers also carrying the whole weight of the building. Over the crushers is the cable tramway, extending over the trestle to the quarry. The tramway is what is known as the shuttle cable system, run by a 25 horse power motor and furnished by the Rawson & Morrison Manufacturing Company of Boston, Mass. All the crushers are driven from one line shaft, which in turn is driven by motor of sufficient size. From the crushers the material is taken by gravity into large stock bins directly underneath.

2d. Dryer building—The drying department consists of a series of buildings. All the outer walls are of brick the same as the walls of the other buildings in the mill. The dryer building contains six dryers of the ordinary type, divided into three sets, manufactured by the Vulcan Iron Works of Wilkes Barre, Pa. Each set driven by its own separate motor of sufficient size. In connection with each dryer is also an elevator and a charging scale.

3d. Rawstone grinding mill—In said mill there are installed six Krupp batteries; each battery consisting of a No. 8 ball mill and one 22 foot tube mill. Each ball mill is furnished with an elevator as well as a very short belt conveyor. The Krupp batteries are divided into three sets; each set driven by its own individual motor of sufficient power. From the rawstone grinding building there are two direct entrances into the engine room. In leaving the rawstone grinding building we find that there are two kiln departments, two finishing mill departments and two stock houses and we also find that the power room, boiler room, machine shop and cooper shop are centralized between the above duplicate departments.

The writer's reasons for this construction are as follows: There has always been a more or less tendency to monopolize power as much as possible in cement mills so far and it is known to the writer that even such small accidents as the breaking of a link chain or conveyor will in some instances stop a whole mill and thus repairs that are only worth a few dollars cause a loss that will soon run up into hundreds owing to the failure of distributing power to such an extent that the grinding machinery

and burning machinery are distinctly independent of each other relative to the generating as well as motive power.

4th. Two kiln buildings—In each kiln building there has been installed 10 kilns 45 feet long and 6 feet in diameter. All kilns are lined with 9 inch lining of special make. Each kiln is controlled by Reeves variable speeders. The same system of control is used on the screw conveyors under stock bins to take the raw material into water jacketted feed pipes. Same system is also used on the coal apparatus. At each end of the kiln buildings is a special department, namely, coal grinding department, in which the slack coal is dryed by ordinary Vulcan Iron Works dryers and ground in Krupp 22 feet tube mills. Each set of kilns, dryers and tube mills are driven by individual motors of ample power.

5th. Two finishing mill buildings—In these buildings are installed altogether 8 Krupp batteries of same size as found in rawstone grinding building. Each ball mill and tube mill, however, are here connected with their own individual elevators to convey material from mill to mill. The Krupp batteries are divided into four sets; each set driven by its own individual motor.

6th. Two stock houses—The stock houses have each 10 bins; each bin sufficiently large to carry between 3,000 and 4,000 barrels of cement in bulk. Every two bins have their own battery of elevator and packer into which the material is conveyed partly by gravity and partly by wheeling.

7th. Machine shop—Said building is situated between two stock houses and is a five story building. On the first floor is found the machine shop and four small steam engines. Said engines are driving the packers and elevators in the two stock houses as well as the freight elevator in cooper shop and machinery on first and second floors. The second floor is taken up by the cooper shop, which is equipped with L. M. Reed's barrel machinery throughout. The third and fourth floors are storage rooms for barrel stock and fifth floor for ready made barrels.

8th. Boiler room—In the boiler rooms are installed 2,000 horse power Stirling boilers in four batteries of 500 each; each battery being divided into two units; each unit having its own separate smoke stack.

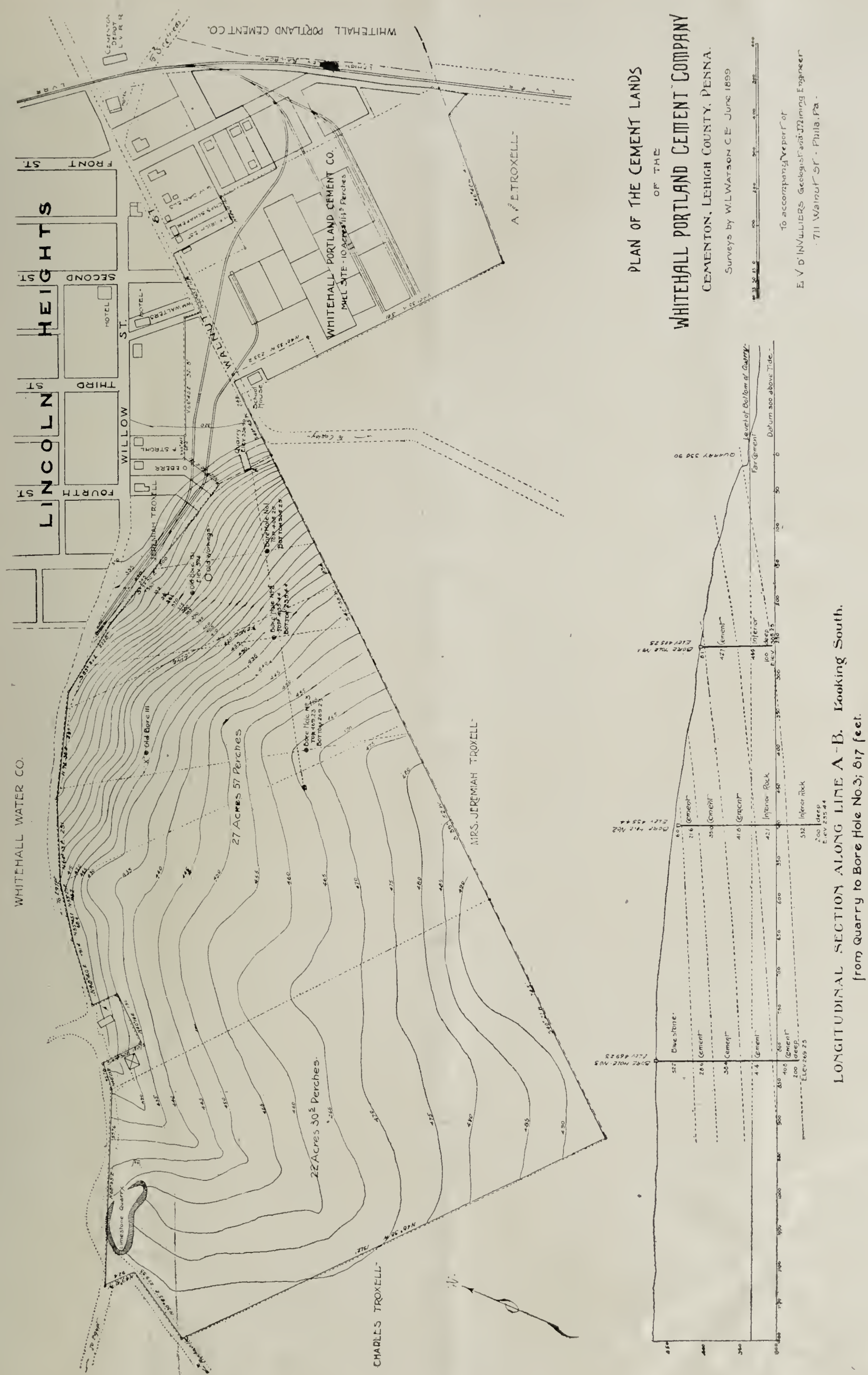
Between the stock house and machine shop on one side and the two finishing mill buildings and the boiler room on the other side is a railroad trestle of extremely strong construction underneath which eighteen feet high coal pockets have been constructed and from which the coal runs directly into the boiler room; thus doing away with any rehandling.

9th. Engine room—This building is equipped with four large generators divided into two sets; each set driven by sufficiently large cross-compound condensing or non-condensing engines of Corliss type and made by the Vulcan Iron Works, Wilkes Barre, Pa. In this building is also installed the motive power for all the machinery in the kiln building and coal grinding department. At the end of the room in said building is a switch board about 40 feet long and from this switch board is controlled the whole motive power throughout the plant. The two engines are equipped with automatic stops of the Monarch Manufacturing Company's system and in case of accident the engines can be stopped from any part of the mill by means of an electric button.

10th. Auxiliary power building—In said building, which is entirely separate from the mill as shown on the plan, is installed a Greene improved engine made by the Providence Engineering Works. Said engine driving one set of generators; said set equal in power to the two sets in building No. 9. This auxiliary generating power will be used only in case of emergency and is connected by cables to main switch board in engine room so that should any breakdowns occur on the two engines and the two sets of generators in engine room No. 9, the closing of two switches and the opening of a valve will put the motive power in instant connection with the generating power in the auxiliary building.

12th. Electric light building—Said building contains three Westinghouse automatic engines of the junior type and each engine driving an electric dynamo of the Lundell patent. Said building also contains

WHITEHALL PORTLAND CEMENT COMPANY'S WORKS AT CEMENTON, PA.


PLAN OF THE CEMENT LANDS
OF THE
WHITEHALL PORTLAND CEMENT COMPANY
CEMENTON, LEHIGH COUNTY, PENNA.
Surveys by W. L. WATSON C.E. June 1899
To accompany Report of
E. V. D'INVILLIERS Geologist and Mining Engineer
711 Walnut St. - Phila. Pa.
LONGITUDINAL SECTION ALONG LINE A-B. Looking South.
from Quarry to Bore Hole No. 3; 817 feet.
Vertical & Horizontal Scale alike.
WHITEHALL PORTLAND CEMENT CO.
WHITEHALL WATER CO.
LINCOLN HEIGHTS
FRONT ST.
SECOND ST.
THIRD ST.
FOURTH ST.
WILLOW ST.
WALNUT ST.
WHITEHALL PORTLAND CEMENT CO.
MILL SITE - 10 Acres 115 Perches
27 Acres 57 Perches
22 Acres 30 Perches
MRS. JEREMIAH TROXELL
CHARLES TROXELL
A. & E. TROXELL
School House
Limestone Quarry
Old Workings
Old Bore 111
Bore Hole No. 3
Bore Hole No. 2
Bore Hole No. 1
Quarry
Cement
Inferior Rock
Blue stone
Level of Bottom of Quarry
Datum 300 above Tide.

supply room as well as air compressor, which furnishes the air for three or more steam drills that are used up in the quarry.

The run of the material is as follows:

The material is loaded on cars in quarry. Signal is given to man at cable motor controller and the car is taken by cable to whatever crusher required. The cars are automatic side dumpers of ordinary type. As soon as the car has discharged its contents the man at the controller reverses the lever and the empty car starts back to the quarry and is met on its way down by another loaded car coming up emptying itself in a similar way. Each crusher has spout connection to either cement rock or limestone bins and consequently limestone or rock can be crushed by the same crusher by merely changing the slide in the spout. The stock bins at the upper end of the dryer building and underneath crushers have a storage capacity of between 4,000 and 5,000 tons of crushed rock. From the stock bins the crushed rock is mixed in right quantities and taken into elevators discharging into the dryers, which are fired from the lower end whenever occasion requires. It may astonish readers of this to hear that the system of mixing is the old fashioned one, but the writer has found that the accuracy is no more distinct by the automatic weighing machines than it is when done by hand by the use of the regular furnace charging scales, in which case the scales are under the chemist's sole control. Furthermore the cost in using this old fashioned method is less in proportion than the use of conveyors and elevators in connection with automatic weighing machines, which requires manual labor at the same time. Breakdowns at this particular point is a very serious thing and when one must depend on machinery alone to do the work, I think that the idea is only too clear when I say that in using manual labor, which is in this section of the country very cheap, breakdowns can never occur at this particular point.

The material passes through the dryers and from there into a small belt conveyor which takes it into an elevator in the rawstone grinding mill. Said elevator discharges into a Krupp ball mill, where the crushed material is ground to such a fineness as to warrant an efficient output from the tube mill, which in this case is set right under the Krupp mill, thus doing away with any elevator whatever at this point. The tube mill is driven by means of a bevel gear, which makes it possible to use far less space than would otherwise be required. From the tube mill the material is taken in a short screw conveyor which lies on top of the cement floor to an elevator which carries the material up into steel stock bins over the kilns in the kiln building. From the stock bins the material is then fed into the rotary kilns where it is clinkered and discharged into clinker storage bins which are lying at the depth of 18 feet below floor level in kiln building. Two kilns discharge into one bin at any one time. Cooling towers are done away with here entirely. The clinkers are given ample time to cool themselves before they are being taken out into the finishing mill for grinding. The rising heat in the clinker bins is taken off by means of large exhaust fans into the boiler room where it is utilized under the boilers in order to create forced draft as nothing else but culm is used for firing purposes. The clinkers are taken into the elevators in the finishing mill and from there discharged through percussion feeders into the ball mills where they are ground down to sufficient fineness to warrant a profitable output in the tube mill. From the ball mills the ground clinkers are taken into another elevator which discharges itself into a large hopper above the tube mills. At this junction the final mixture is made and the material passes into the tube mill from which it is discharged into a short screw conveyor as finished cement. The conveyor is lying on top of the floor. This conveyor discharges into another short conveyor which in turn takes it to an elevator standing in the stock house and discharges the material on a belt conveyor distributing the cement in whatever bins are ready to receive same.

With the above facts in mind the writer wishes to call the attention of a few points as follows:

1st. Care has been taken to make everything as strong and up to date as possible avoiding all technicalities, bearing in mind nothing else but what practical and actual experience has shown or brought to light. The old saying, "Make it too strong and you will never find it out, make it too light and you will only find it out too soon," has been in the writer's mind throughout and it should be more than astonishing if very serious accidents would occur save actual wear and tear, which nobody can prevent.

2d. Simplicity and uniformity in construction. One type of crushers, one type of grinding machinery and the grinding machinery made by a manufacturer whose name alone is enough to warrant their solidity before the most critical of critics.

3d. The absence of long conveyor lines.

4th. The absence of sprocket chains and sprockets for driving purposes.

5th. The distribution of power to such an extent that even one-sixth of the mill can be run from beginning to end without interfering with any other part of the mill.

6th. The erection of good substantial brick and iron buildings making the buildings practically fireproof and what is more important dustproof if compared with some of the mills now in existence.

7th. One hundred and sixty-four men are required to run the mill night and day.

8th. The writer had a contract with the company to construct the plant that would turn out 2,000 barrels every 24 hours. Any man that understands the handling of the cement plant can run out without difficulty in the stock house 2,500 barrels in the same period and the writer would not be surprised to see even 3,000 barrels made under favorable circumstances per day. The cost of the mill alone is in the neighborhood of $700,000.

9th. Some of the most prominent makers of machinery that has been used are as follows:

Krupps, Gruson Werke, represented by Thos. Prosser & Son, New York City, grinding machinery; R. McCully, Philadelphia, Pa., crushers; Keystone Electric Company, Erie, Pa., electric machinery; Vulcan Iron Works, Wilkesbarre, Pa., kilns, dryers and engines; Stirling Boiler Company, Chicago, Ill., boilers; Groton Bridge & Mfg. Co., Groton, N. Y., structural iron; Emanuel & Son, Catasauqua, Pa., condenser tunnel, concrete floors and furnace slag; W. N. Thayer, New York City, electric lighting plant; Rawson & Morrison Mfg. Co., Boston, Mass., cable tramway; B. F. Sturtevant Company, Boston, Mass., pulverized coal apparatus; J. B. & J. M. Cornell, New York City, structural iron, fans, etc.; Wm. F. Mosser & Son, Allentown, Pa., conveyors, etc.; Chicago Belting Company, Chicago, Ill., belting; Jeffrey Manufacturing Co., Columbus, O., elevators; Hull Clutch Company, Cleveland, O., journals, pulleys, etc.

The following figures may be interesting: 27,000 cubic yards of concrete have been used in the foundations of the buildings as well as of the machinery; 4,000,000 brick and 1,000 tons of structural iron.

Under proper management the cost per barrel at the rate of 2,000 barrels in this mill should be:

Quarrying	$4\frac{8}{10}$	cents.
Conveying to crushers	$1\frac{1}{10}$	"
Crushing	$1\frac{1}{10}$	"
Limestone crushed	$6\frac{6}{10}$	"
Mixing and drying	$2\frac{1}{10}$	"

Rawstone grinding	$0\frac{5}{10}$	cents.
Burning	$18\frac{1}{10}$	"
Coal grinding conveyor	$1\frac{3}{10}$	"
Clinker grinding	$6\frac{1}{10}$	"
Packing and loading	$3\frac{3}{10}$	"
Steam producing	$5\frac{9}{10}$	"
Generating power	$1\frac{7}{10}$	"
Office and general expense	$2\frac{5}{10}$	"
Analyzing expenses	$0\frac{6}{10}$	"
Total manufacturing cost	$55\frac{7}{10}$	"

These figures give a very large margin for repairs and accidents, etc., etc., amounting to nearly 3 cents per barrel.

In conclusion the writer wishes to express his thanks to all that have assisted him in the erection of this mill and especially wishes to mention the board of directors and the office force for their untiring and unselfish efforts in enabling him to put in operation a plant, which he has no doubt will hold its own both from a technical and economical standpoint.

GERMANY.

EXPORT OF CEMENT IN TONS.

TO	JUNE.		JAN.-JUNE.	
	1899	1900	1899	1900
Freeport, Hamburg	680	1,610	2,859	8,236
Belgium	503	276	3,052	2,182
Denmark	1,102	1,487	4,882	4.624
Great Britain	52	371	1,800	2.458
Holland	3.6 9	5,443	19,650	24,848
Norway	2,058	1,085	8,073	7,140
Austria	2,370	2,577	9,777	9,824
Russia	5.528	2,684	12,406	7,791
Finland	2,479	1,910	3,026	3,912
Switzerland	1,229	828	6,050	3,631
Cape Colony	87	1,264	2 241	3,961
Transvaal	221	341	4,022	936
China	2,644	.....	13,613	3,432
Other East Indies	439	1,601	5,129	6,407
Argentine	.....	166	4,638	6,206
Brazil	1,292	1,631	8,140	10,343
British North America	815	801	1.809	2,399
Chili	973	1,235	4,687	4,574
United States	22,546	15,114	101,005	127,200
Australasia	3,235	2,688	17,488	17,507
Totals, with others	53,605	47,733	249,133	280,125
1898	57,978	.....	241,226	.....
1897	52,090	.....	227,595	.....

UNITED KINGDOM.

EXPORT OF CEMENT IN TONS.

TO	JULY.		JAN.-JULY.	
	1899	1900	1899	1900
Holland	359	510	2,371	2,605
United States	4,524	6,086	18,116	30,894
Brazil	1,386	946	9,333	6,239
Argentine Republic	1,406	1,345	8,990	10,973
British South Africa	5,889	4,327	24,957	25,875
British East Indies	2,715	2,770	25,345	27,381
Australasia	3,352	4,335	21,173	19,514
Canada	1,763	4,401	7.942	18,076
All others	15,680	14,536	90,823	105,495
Totals	37,074	39,256	209,050	247,052

Exports of cement for May, 1898, were 25,955 tons; from January to May, 1898, 140,294 tons.

IMPORT OF CEMENT INTO UNITED KINGDOM, 1900.

MONTHS.	TONS.	VALUE £
January	3,934	8,082
February	7,018	14,857
March	5,401	12,213
April	7,918	17,694
May	9,820	21,115
June	9,139	20,262
July	9,439	18,806

ENGLAND.

CEMENT SHIPPED FROM PORT OF LONDON, July, 1900.

TO	TONS	TO	TONS
Adelaide	174	Malta	36
Aden	15	Manila	17
Alexandria	2,713	Melbourne	404
Algoa Bay	84	Montevideo	175
Amsterdam	153	Montreal	1,205
Antwerp	11	Mossel Bay	72
Auckland	89	Nelson	107
Baltimore	54	Newcastle	179
Beunos Ayres	1,092	New Orleans	257
Bangkok	18	Newport News	300
Bermuda	94	New York	92
Bluff Harbour	63	Odessa	48
Boca	854	Otago	362
Bombay	8	Ostend	26
Boston	173	Paris	237
Brisbane	357	Penang	471
Brussels	26	Pt. Elizabeth	1,049
Calcutta	899	Pt. Limon	13
Capetown	1,778	Puget Sound	286
Channel Isles	260	Rangoon	7
Colombo	793	Rio Janeiro	53
Constantinople	287	Rotterdam	143
Copenhagen	29	Sangon	2
Delagoa Bay	125	San Francisco	3,079
Durban	357	Santos	342
East London	335	Seville	10
Fremantle	1,256	Seychelles	3
Galatz	20	Singapore	107
Gibraltar	2,546	St. Helena	19
Halifax	841	St. John, N. B	392
Hamburg	45	St. Lucia	6
Harlingen	44	St. Petersburg	15
Hobart	85	Surinam	44
Honolulu	619	Sydney	509
Invercargill	33	Sydney, C. B	4,309
Jaffa	39	Tampico	34
Jamaica	704	Tunarn	125
Kunachee	64	Trinidad	560
La Plata	67	Valparaiso	1,901
Launceston	96	Vera Cruz	900
Lisbon	178	Vladivistock	8
Madia	89	Wellington	614
Malaja	2		

BELGIUM.

EXPORT OF CEMENT IN TONS.

TO	JUNE	JAN.-JUNE.		
	1900	1900	1899	1898
Germany	325	2,075	1 986	2,705
Great Britain	7,796	34.982	41,791	20,917
Australasia	78	1.380	5 243	1,364
Brazil	1,721	11,507	7,560	10,840
Canada	2,336	7,066	5,081	11,363
Cape Colony	479	1,848	2,670	2,009
Chili	182	376	662	805
China	123	1,563	2,262	4,033
Cuba and Porto Rica	157	2,088	2,426	183
Egypt	495	6,125	8,330	4,226
Spain	209	3,128	4,390	2,005
Congo Free State	312	734	609	624
United States	15,598	65,025	46,461	65,403
France	937	6,591	4,886	4,926
British East Indies	968	3,782	4,182	3,663
Japan	2	14	584	4,149
Mexico	33	2,361	2,231	1,260
Natal	530	1,151	4,585	891
Norway	1,016	3.786	5,252	2,396
Holland	4,632	23,379	19,815	18,960
Portugal	334	2,812	2,240	1,849
Argentine	1,298	15,557	19,754	13,819
Roumania	.....	128	1,245	901
Russia	53	577	1,052	873
Turkey	.....	50	250	268
Uruguay	141	271	376	466
All others	1,061	6,970	7,567	5,450
Total (kils.)	.....	205339	208,501	186,362
June only	41,008	.....	45.046	39,068
Full years	.....	.....	449,936	419,131

McKELVEY HAND POWER CONCRETE MIXER. HOW CONTRACTORS LIKE IT.

BLOODGOOD & STOUT,

CONTRACTORS FOR STREET PAVING.

CEMENT SIDEWALKS A SPECIALTY.

OFFICE:
FIRST FLOOR CITY BUILDING.

HARVEY, ILL., Aug. 16, 1900.

McKELVEY CONCRETE MACHINERY CO.,
CHICAGO, ILL.

GENTLEMEN: We purchased one of your concrete mixers and have been using it for about one month, and find it more than you claimed for it at the time I saw you in your office in the City of Chicago. We have laid 4,000 superficial feet of sidewalk in nine hours and moved the machine along about fifteen times. We have put through $1\frac{1}{2}$ yards of concrete in five minutes and mixed it better than it could be mixed by hand if shoveled over ten times. It is the king bee for mixing concrete. It will surely add 20 per cent to strength of concrete by putting it through your mixer. It is so simple in construction it cannot get out of order, and the weather cannot harm it to any degree.

We would advise those who use this mixer to give it about three inches pitch, having the receiving end about three inches higher than the outlet.

Yours respectfully,
BLOODGOOD & STOUT,
Contractors for all kinds of concrete work.

Mr. R. G. Bush, formerly superintendent of the Lawrence Cement Co., has accepted the position of general superintendent of the Reading Cement Company of Reading, Pa.

The Krause & Sons Cement Co. of Martin's Creek, Pa., have a contract with the United States government for the delivery of 30,000 barrels of Krause Portland cement for the new Bureau of Printing and Engraving Building, Washington, D. C.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	JUNE.				TWELVE MONTHS ENDING JUNE.			
	1899.		1900.		1899.		1900.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom	2,364,000	8,943	3,871,364	14,692	100,592,130	368,253	95.778,264	377,530
Belgium	31,733 273	99,041	37,801,158	121,115	265,274,395	789,268	297,704,778	873,816
France	595,200	2,415	.....	.....	7,655,200	24,170	6,182,997	23,946
Germany	58,318,110	207,470	54,817,342	203,447	442,660,779	1,535,258	505,185,216	1,860,560
All Other Europe	1,970,757	5,008	1,857,200	5,422	16,290,544	50,611	27,195,262	86,170
British North Am.	691,925	3,019	208,100	984	1,946,070	8,767	1,461.990	7,839
Other Countries	.....	.....	752,420	3,252	2,000	9	5,335,580	24,659
TOTAL	95,673,265	325,896	99,307,584	348,912	834,421,118	2,776,336	938,844,087	3,254,520
Domestic Exports of Cements, bbls.	4,558	10,143	5,934	13,194	64,122	131,361	76,025	163,162

There were 2,958,539 lbs. of imported Roman and Portland cements, etc., in the United States bonded wa houses on June 30, 1899, valued at $8,546, against 10,406,211 lbs., valued at $36,145 in June, 1900.

Imports of asphaltum or bitumen for June, 1899, were 13,618 tons valued at $32,080; June, 1900—8,518 tons valued at $42,343. For twelve months ending June, 1899, 73,494 tons valued at $234,420; for twelve months ending June, 1900—106,162 tons valued at $363,291.

Incorporated: The American Cement Tile Co. of Pittsburg. Capital $50,000.

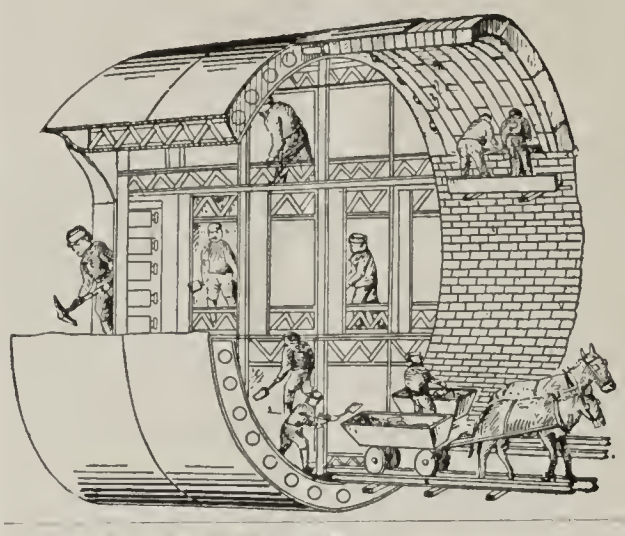
The Burns Cement Plaster Company of Burns, Kan., is doubling the capacity of its plant.

The affairs of the Kentucky Cement Co. of Valley Station, Ky., are in court. A receiver is asked for.

The South Bend Portland Cement Co. will construct an electric tramway from its marl deposits at Lake St. George to its works at South Bend, Ind.

Danville, Ill., has passed an ordinance prohibiting the laying of brick sidewalks, imposing a penalty of from $5 to $100 for violations. Cement walks are to be laid hereafter.

THE HASTINGS TUNNELING SHIELD.



Two of these shields are now in operation in the Chicago Intercepting Sewer System on a 24 foot 9 inch bore.

Estimates Furnished for Tunnels of Any Size.

Correspondence solicited for the use of this shield.

Address

C. G. HASTINGS,
Inventor and Patentee,
1401 MONADNOCK BUILDING,
CHICAGO, ILL.

"ALUMNITE" FIRE BRICK.

[REGISTERED TRADE MARK.]

The most successful brick manufactured for rotary kilns.
Made especially for this work after long experience.
Plans and designs for rotaries and improved linings.

THE STOWE-FULLER CO.
Sole Manufacturers,
249 The Arcade. CLEVELAND, O.

SHAW-WALKER CARD SYSTEMS

help business men in keeping records of customers—prices—stock—costs—plans—drawings, etc., that are difficult to keep with books.

AN INSTRUCTIVE CATALOG

telling all about them and a bunch of sample cards showing how other concerns in any particular line of business use the system are free.

THE SHAW-WALKER CO., MUSKEGON, MICH.

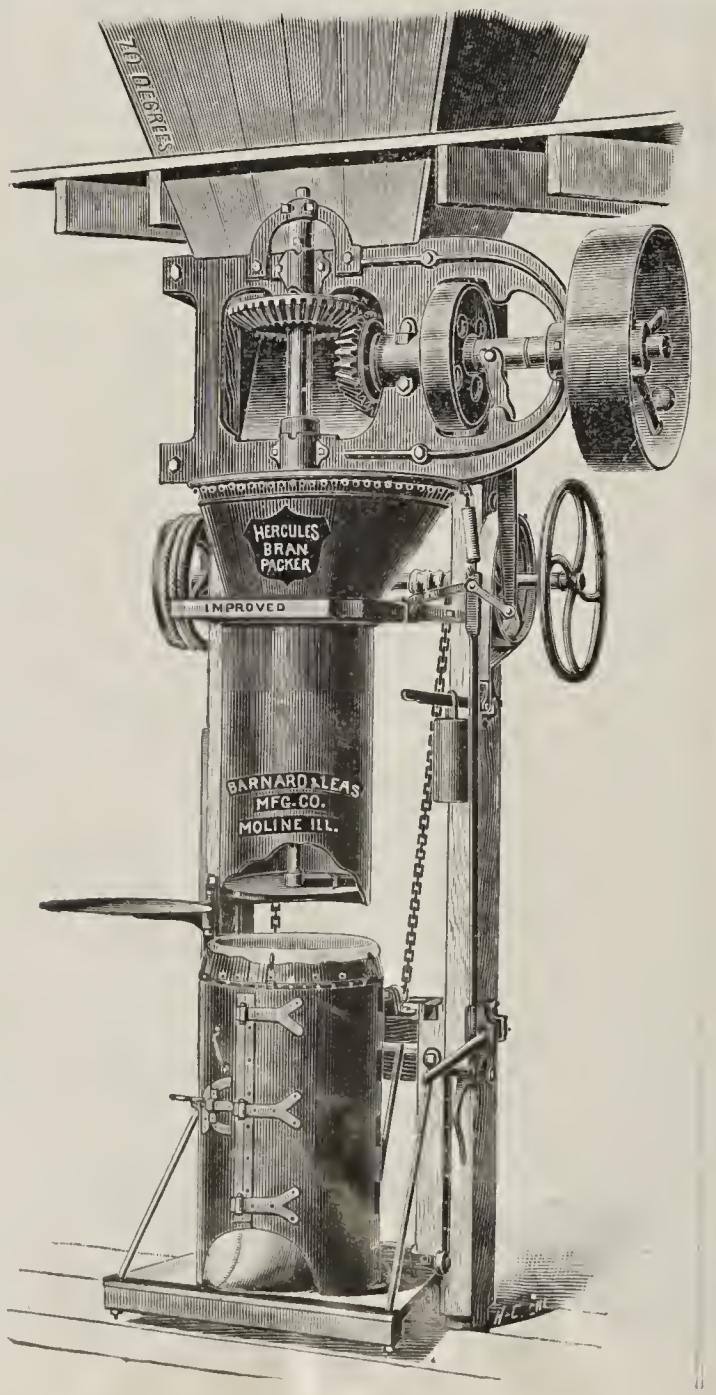
WANTED!

Position as Chemist or Assistant Chemist in Portland Cement works by a technical graduate. Can give references. Address "CHEMIST E." care of the *Cement and Engineering News*, 161 La Salle Street, Chicago.

FOR SALE

On account of Removal, two Sturtevant Mills in good order and for immediate delivery.

Box 256, Hyde Park, Dutchess Co., N. Y.



TAKE NOTICE.

Why use inferior Packers when you can get the

HERCULES ?

Has **no equal** for packing Cement, Plaster-of-Paris, Dry Paint and all kinds of pulverized materials.

An iron frame supports the counter-shaft and pulley so that no outer bearing is required, and the settling of the floors does not get the shaft, gears or friction clutch out of line with each other.

All parts made especially strong and heavy, and from the best materials.

Will pack Barrels and Sacks.

The outside case (shown in cut) is not used in packing cement or other heavy materials.

Give this machine a trial. You will not regret it.

MADE BY

BARNARD & LEAS MFG. CO.,
MILL BUILDERS AND MILL FURNISHERS,
MOLINE, ILL.

The Link Belt Machinery Co.,

Engineers • Founders • Machinsits, Chicago, Ill.

Designers and Builders of

LINK-BELT Elevators & Conveyors

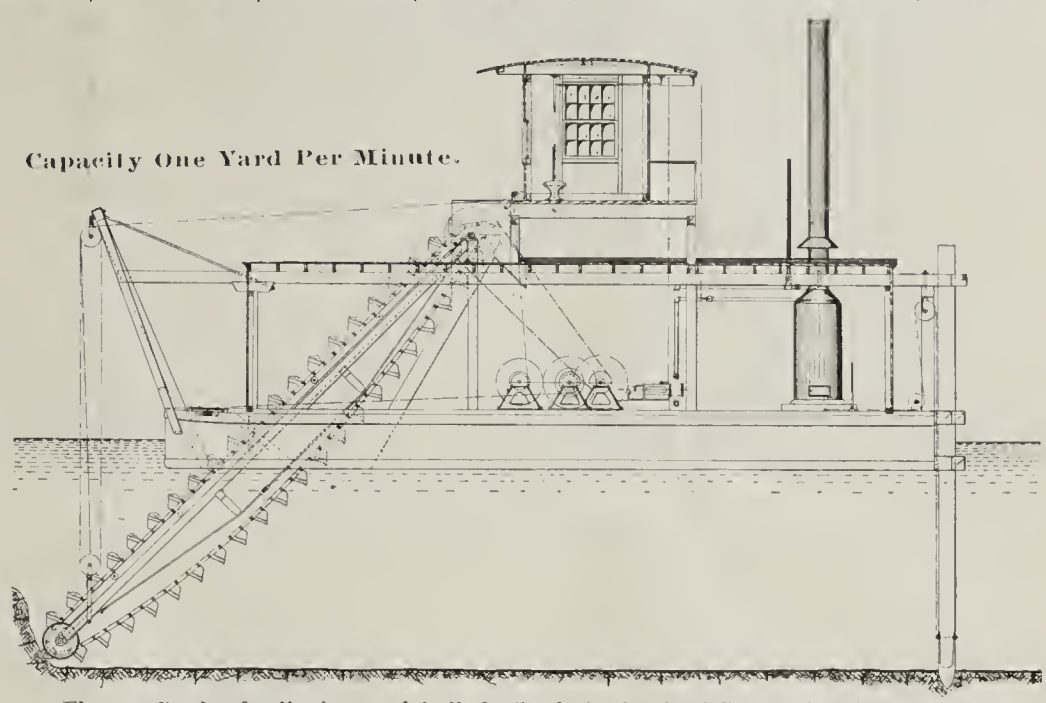
FOR HANDLING

Limestone, Phosphate Rock, Cement, Sand, Ores, Lime, Gravel, Coal, etc.

MODERN METHODS,

Catalog No. 25,

illustrating and describing Link Belt Elevators and Conveyors. Special Cement Handling Machinery, Link Belting, Special Carrier Chains, Sprocket Wheels, Patent Machine-Molded Rope Sheaves, Shafting, Pulleys Clutches, and General Mill Supplies, mailed upon application.



Elevator Dredge for digging marl, built for Sandusky Portland Cement Co., Syracuse, Ind.

A TREATISE

ON

Masonry Construction.

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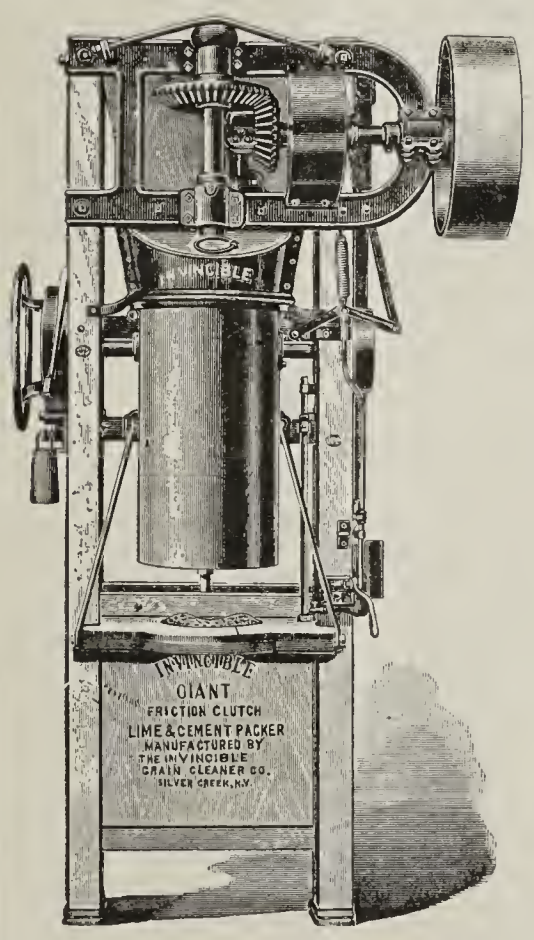

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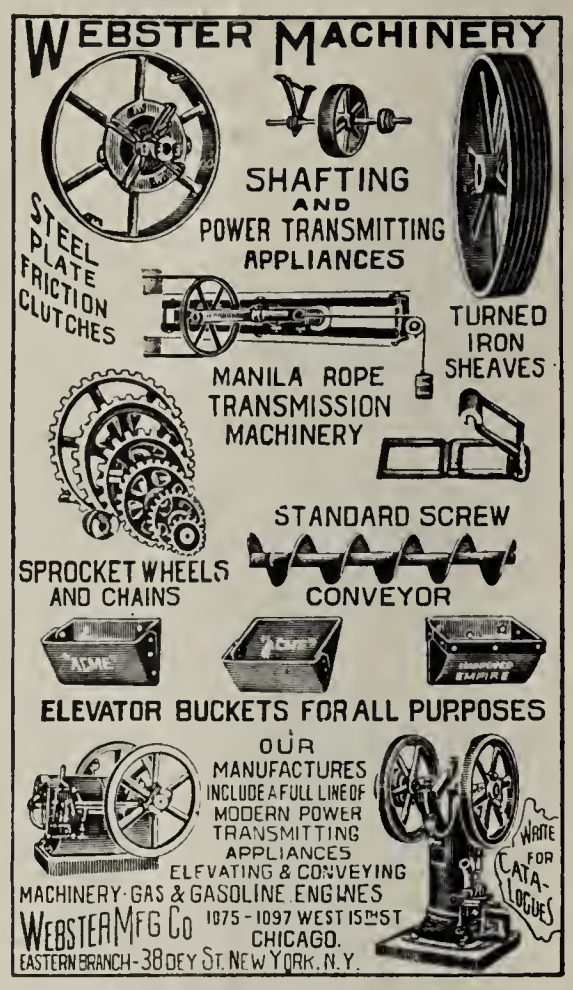

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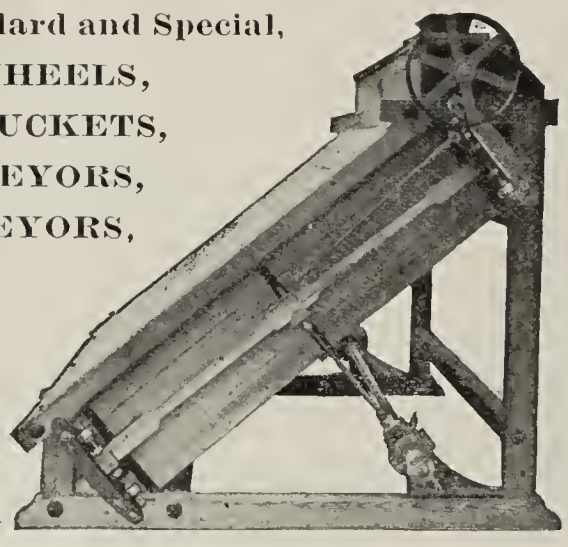

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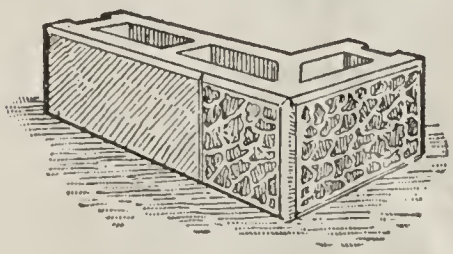

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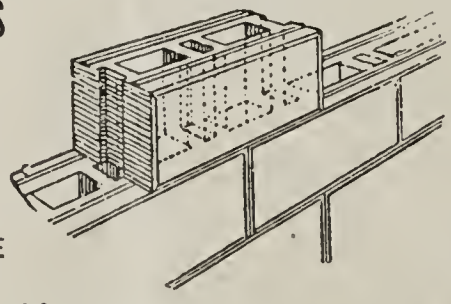

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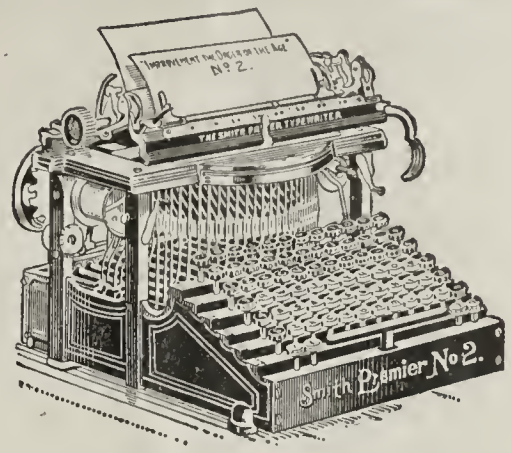

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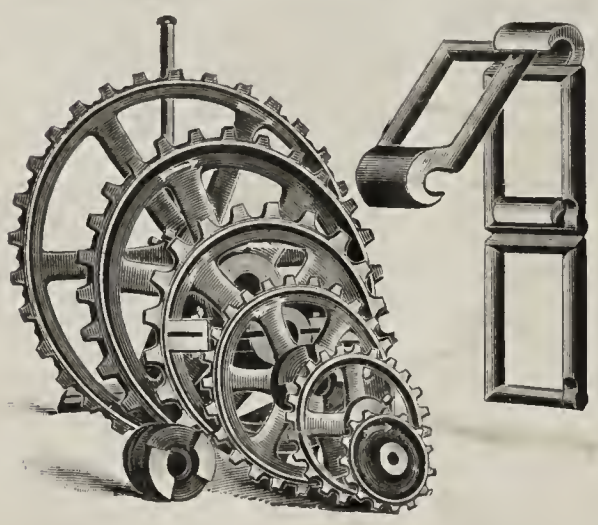

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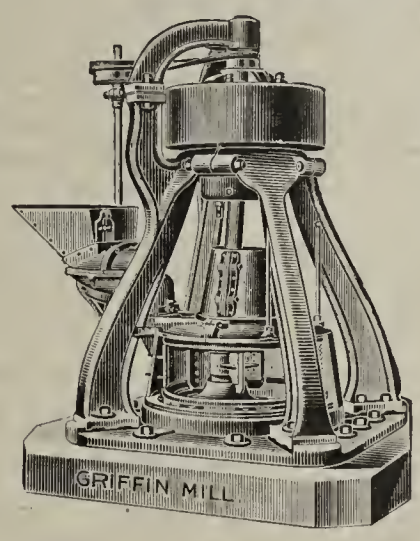

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Over-production has forced down prices in several instances in the Lehigh cement belt from 15 to 18 cents per barrel below the Belgian export rate on sales for South American points on 1,000-barrel lots. The entire South American cement trade is now in the hands of German, English and Belgian cement manufacturers. In May of the present year Brazil imported from Germany 2,702 tons of Portland cement, and from January 1st to May 30, 1900, 8,711 tons from the same country. Brazil imported from Belgium for four months, ending April 30, 8,739 tons of Portland, and from England from January to July 30, 6,239 tons.

Portland cement prices rule high throughout the South American states; late quotations from Rio de Janeiro range from $10.26 to $12.42 per cask. The Argentine Republic's cement imports for six months ending June 30, 1900, were from Germany, 6,206 tons; from England, 10,973 tons and from Belgium, 15,557 tons.

In Mexico, Germany and England have the Portland cement trade. Shipping facilities from Europe to South American points are excellent, while the reverse is true from the United States. Better rates from South America to and from the United States, via Europe, are the rule. This seriously hampers direct trade between the United States and South America. Notwithstanding these obstacles the American cement manufacturer should reach out for South American trade. When once a foothold has been obtained a steady and growing demand will be assured. The field is open and should be cultivated for all it is worth.

The Pan American Exposition, to be held at Buffalo, N. Y., next year, will bring the manufacturers of the United States in contact with many of the leading South American merchants. The opportunity should not be lost by the United States cement producers.

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The Lakefield Portland Cement Company, Limited, of Lakefield, Ont., are making progress toward the completion of their plant. Their main building will be 326 ft. in length, 80 ft. in breadth, and 22 ft. high, and will be constructed of the new material known as Stevens Litholite, an artificial stone composed of Portland cement, coarse sand or ground rock, molden in sand and hollow. The blocks will be prepared of the uniform dimensions 12 ins. by 30 and laid in cement mortar. The roof will be a wooden truss sheeted with metal. Their deposit known as Buckley's lake, is known to be one of the most extensive marl deposits in the Dominion, contains about 800 acres, and of a depth of 20 ft. and over, is of great strength and purity, and situated about a mile and a half east of the works. A railway is being constructed between the works and the deposit. The marl will be dug by a clam shell digger and conveyed to the works by a train of iron dump cars and a small steam motor.

The company have purchased the Young's Point mills and water power and have removed the mills, and are removing also two piers of the dam for the purpose of increasing the inflow to their wheels. There will be four concrete flumes erected each of 22 ft. in breadth, abutting against the face of the dam, and with wheel pits 13 ft. in depth, so as to afford the fullest relief to the large body of water to be used in the power. The flow from several lakes converges at this point affording a steady and abundant supply.

The electric power, pole line, telephone line, motors, etc., are being built by the Canadian General Electric Co. The electric plant will combine all the latest improvements known to electric science. Ten electric motors ranging from 10 horse power to 75 horse power will drive the plant.

Machinery will be installed at the present time to turn out 300 bbls. per day, but the power will be sufficient to propel, and the building large enough to contain and accommodate a plant capable of turning out additional 300 bbls. per day.

Messrs. R. P. Butchart, general manager of the Owen Sound Portland Cement Co. and W. H. E. Bravender, manager of the Empire Cement Works, located at Warners, New York State, and who are joint vice-presidents of the company, are engineering the plant, which will be of the latest construction. The cement turned out by both of these companies, holds first place in the trade, the Owen Sound Co. having secured a silver medal for their product at the Paris Exposition, which will be a sufficient gua antee of the excellence of the product of the Lakefield Portland Cement Co.

The village of Lakefield has given the enterprise a bonus of $10,000 together with a grant of thirteen acres of land lying alongside the Grand Trunk Railway tracks in the village, also an exemption from taxation for the period of ten years. The authorized capital of the company is $500,000. All this is expected to be paid up.

The advantageous position of the company's works upon the Trent canal and Grand Trunk railway, its magnificent marl deposits, its splendid water power, as well as the long experience and thorough knowledge of the business by its manager, gives every reason to hope that this company will have a long and prosperous career.—*Canadian Architect.*

Port Huron, Mich., will lay seven miles of cement walk.

Richford, Vt., has appropriated $2,500 for cement walks. Earlier in the season $2,000 was appropriated for the same purpose.

The new addition to the American cement company's mill at Egypt, Pa., is now in operation, increasing the output of the works 700 bbls. per day.

Grand Prix has been awarded the CEMENT AND ENGINEERING NEWS on its exhibit of bound volumes at the Paris Universal Exposition. The Grand Prix is the highest award within the gift of the Exposition, excepting only a personal decoration.

Plans have been completed for two mills to be erected by the Cumberland and Potomac Cement Manufacturing Company at Pinto, Allegany county, Md.

Walter Wilson superintendent of the Banner Cement Works near Sellersburg, Ind., was killed September 18 while blasting rock at the company's quarries. Three workmen were injured at the same time.

Incorporated: The American Stone and Conduit Company of Terre Haute, Ind. Capital $100,000. To manufacture artificial building stone and multiple duct conduits and roofing tile.

Incorporated: Texas Asphalt Paving Company of San Antonio, Tex. Capital stock $50,000. Incorporated by J. H Briggs of Cline, J. P. Nelson, J. S. McNamara of San Antonio.

INTERIOR VIEW COLISEUM BUILDING, CHICAGO.

Showing the steel roof construction with the exposed concrete panels of the under side of the roof. The Coliseum is the largest auditorium building west of New York. The expanded metal work was done by the Northwestern Expanded Metal Co. of Chicago.

The Jeffrey Manufacturing Co. of Columbus, O., have a complete chain catalogue ready for distribution. See their card in our advertising columns.

Nazareth Cement Co., Easton, Pa. Mining and quarrying cement. Capital $1,000. Incorporators: G. F. Coffin, H. G. Seip, A. Sausser, all of Easton; D. Wallace, F. A. Stratton, P. H. Hampson, all of New York City.

An advertisement in CEMENT AND ENGINEERING NEWS brings reward.

The American Artificial Stone Paving Co. of Philadelphia will erect a large plant at Yankee Point, Schuylkill river.

The Carolina Portland Cement Co., Charleston, S. C., P. G. Hanahan, secretary, have increased their capital to $15,000.

The Diamond Portland Cement Co. is building a 90-ft. addition to their warehouse at Middle Branch, O.

The Newyago Portland Cement Co. has completed one section of the water power dam and has laid all foundations for its plant.

W. O. Maddux of Xenia, O., has secured the contract for making about 30,000 square feet of concrete pavement at Washington C. H., O.

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HOW TO CALCULATE CEMENT MIXTURES.

Editor Cement and Engineering News:

SIR—Having read with care the paper by W. Michaelis, Jr., entitled "How to Calculate the Proper Cement Raw Mixture From the Given Raw Materials," published in your August issue, I feel justified in dissenting from some of the views advanced by the author and in calling attention to certain erroneous and unjust statements which the paper contains.

Dr. Michaelis, Jr., bases his proposed method of calculating the correct composition of cement mixtures upon the "hydraulic modulus," a factor proposed by Dr. Michaelis, Sr., representing the ratio between the amount of lime and that of silicates (silica, alumina and iron oxide) present in Portland cement. Dr. Michaelis, Jr., states that this ratio must, in practice, lie between 1.8 and 2.2, and recommends the arbitrary figure 2, as a suitable mean, even a slight deviation from which will prove injurious.

It is probably true that the hydraulic modulus of all the Portland cements of commerce, good bad and indifferent, lies between the extremes of 1.8 and 2.2. Such a variation, however, corresponding to one-fifth of the amount of lime present, is far too great to permit so uncertain a factor to be used with benefit. The arbitrary assumption of 2 as the correct hydraulic modulus for all materials is, on the other hand, entirely unjustifiable, and would lead to incorrect results except in the case of materials varying but slightly from a certain chemical composition.

The fact is, the correct hydraulic modulus *is a variable*, differing with materials containing different relative quantities of silica, alumina and iron oxide. A given weight of silica combines with two and one-half times as much lime as the same weight of alumina, and four times as much as the same weight of iron oxide. Very silicious clays require much more lime than those high in alumina and iron. Cements made from certain clays may have a hydraulic modulus of 2.2, while with certain other clays it may be impossible to make cement with a higher modulus than 1.8. If, in the eighty years which have elapsed since Vicat proposed his "hydraulic index" (which is simply the hydraulic modulus expressed in a different manner) we have progressed no further in the study of cement chemistry than the adoption of an arbitrary number representing the ratio of lime to silicates without regard to composition of the latter, the subject must be especially difficult or have been strangely neglected.

Le Chatelier was the first to clearly recognize the variable nature of the hydraulic index, and his well known formulas are, for this reason, expressed in chemical equivalents and not in weights. The writer of this letter has endeavored to follow this branch of Le Chatelier's able work still further, in the hope of arriving at a simple formula for cement mixtures, applicable to all materials. The results of careful experiments, extending over several years, were published in the *Journal of the Society of Chemical Industry*, November 1897, and reprinted in this journal, November 1897. Some of the more important conclusions reached were:

1. Magnesia forms no hydraulic products with clay, and should be disregarded in calculating cement mixtures.

2. Iron oxide, in the proportions in which it exists in ordinary clays, combines with so insignificant a proportion of lime that it may be disregarded in calculating cement mixtures.

3. The composition of Portland cement may be represented by the following formula

$$x\,(3\,CaO\,SiO_2) + y\,(2\,CaO\,Al_2O_3) \quad \text{or,}$$

substituting weights for equivalents

$$\text{Lime} = \text{Silica} \times 2.8 + \text{Alumina} \times 1.1$$

This formula represents the maximum of lime that can be used with safety, a maximum which can be reached only by the most thorough mixing and grinding of the raw materials. Given these conditions, the more nearly the composition of a cement approaches that called for by the formula, the better will be its quality.

Dr. Michaelis, Jr's, paper contains the following paragraph, which the writer of this letter feels justified in assuming to refer to the work just described:

"Recently American chemists tried to repeat Le Chatelier's experiments. Unfortunately they worked under quite different conditions, at a far higher temperature and leaving out of view the fact that at different temperatures different compounds of silica, lime and alumina may be formed. Therefore the results of these experiments are without use for practice. Le Chatelier's formula gave the limits of the proportions on both sides as sure as they are asked for by the limits of the hydraulic modulus 1.8 to 2.2. The new American formula, worked out a temperature where higher limed cements can easily be obtained, yields in practical application cements with a too high hydraulic modulus, it is without use because one-sided."

There is scarcely a word of truth in the above paragraph. The writer's experiments were not carried on at temperatures higher than those reached in ordinary cement manufacture. Neither is it true that the proposed formula gives cements with too high hydraulic modulus. Applied to the materials of which Dr. Michaelis, Jr., gives the analyses, the "new American formula" gives a hydraulic modulus of 2.06, while Dr. Michaelis, (though calculating for a modulus of 2) obtains one of 2.02! It is also clearly stated that the formula represents a *maximum* of lime which can be reached only by a most thorough preparation of the raw materials. With more silicious clays, the American formula leads, and rightly, to a higher hydraulic modulus, up to a maximum of 2.20 in case of one of the leading German Portland cements corresponding exactly with the formula.

As to the statement that the American formula is "without use," the writer can only say that many practical cement chemists have assured him, orally and by letter, that the formula has been of great assistance in their work. In one of the several letters on this subject received from Professor LeChatelier, the latter says: "I am very willing to believe that your formula correctly represents the composition of Portland cement." In view of these assurances the writer cannot believe that the work he has done in this field has been in vain.

As a practical example of the use of the "American formula," let us now apply it to the calculation of cement mixtures made from the chalk and aluminous clay described by Dr. Michaelis, Jr., and also from the same chalk and a more silicious clay. The analysis of these three materials is as follows:

	CHALK (Dr. M. Jr)	CLAY 1 (Dr. M. Jr)	CLAY 2 (Sandusky, O.)
Silica	2.50	55.70	65.41
Alumina	1.40	17.20	16.54
Iron Oxide	1.10	8.30	6.06
Lime	53.00	1.40	2.22
Magnesia	0.20	2.40	1.88
Carbonic Acid	41.80	.....	.....
Sulphuric Acid	.....	1.60	.....
Alkalies	.....	3.30	0.43
Loss on Ignition	.....	10.10	7.46
	100.00	100.00	100.00

The calculation of the proportions of chalk and clay required according to the formula

Lime = silica × 2.8 + alumina × 1.1

will then take the following simple form:

CHALK.

Silica, 2.50 × 2.8 = 7.00 lime
Alumina, 1.40 1.1 = 1.54 "

8.54 " required for silica and alumina present.

Lime, 53.0 — 8.54 = 44.46 available for combination with clay.

CLAY NO. 1.

Silica, 55.70 × 2.8 = 155.96 lime
Alumina, 17.20 × 1.1 = 18.92 "

174.88
Less lime contained 1.40

173.48 " required for 100 parts clay.

$\frac{173.48}{44.46} \times 100 = 390.2$ chalk required for 100 parts clay.

CLAY NO. 2.

Silica, 65.41 × 2.8 = 183.15 lime
Alumina, 17.20 × 1.1 = 18.19 "

201.34 "
Less lime contained 2.22

199.12 lime required for 100 parts clay.

$\frac{199.12}{44.46} \times 100 = 447.8$ chalk required for 100 parts clay.

The calculation of the composition of the resulting cements is a simple problem in chemical arithmetic, and only the results need here be given.

	CEMENT from clay No. 1	CEMENT from clay No. 2
Lime	65.7	67.8
Magnesia	1.0	0.8
Silica	20.6	21.7
Alumina	7.2	6.5
Iron Oxide	4.0	3.1
Sulphuric Acid	0.5	....
Alkalies	1.0	0.1
	100.0	100.0
Hydraulic Modulus $\left(\frac{\text{lime}}{\text{silicates}}\right)$	2.06	2.16

The cement from clay No. 1 is almost identical in composition with that calculated by Dr. Michaelis, Jr., with a modulus of 2.02, the only difference being that the percentage of lime and silica in the latter are 65.2 and 21.0 respectively. In this case, therefore, the "hydraulic modulus" of 2 and the American formula give practically the same results.

The cement from clay No. 2 shows a higher percentage of lime. This is largely due to the much lower proportions of magnesia, iron oxide, and alkalies. It will be noted that the silica in the second cement is also higher, the ratio of lime to silica being nearly the same in both cases.

Though the lime in the second cement is higher than in commercial Portlands, this composition can be easily reached in practice, and perfectly sound cement obtained, by sufficiently fine grinding of the raw mixture. In laboratory tests of new cement materials the writer invariably follows the "American formula." The materials are, however, ground together with water for two or three hours in a small porcelain pebble mill, and are thus very perfectly mixed and finely ground. By this method, and burning at the ordinary temperature of the test kiln with coke or gas fuel and natural draft, cement of remarkable strength and constant volume is invariably obtained. In the manufacture of cement on a large scale it is impossible to prepare the mixture so perfectly as in the laboratory. The coarser the mixture, the lower must be the proportion of lime, and the less the composition can be allowed to vary from a certain standard. It is impossible to give any rule for the reduction in lime necessary to offset bad mixing. The *best cement* which can be obtained from given materials will correspond closely in composition with that called for by the formula.

Some of the best commercial cements, in fact, show a surprising agreement with the formula in question, and a "modulus" far above the arbitrary number 2, recommended by Dr. Michaelis, Jr. For example, the analysis of the Germania Portland cement, as given in the circular of the German manufacturers, is:

Lime, 66.04; magnesia, 1.11; silica, 21.14; alumina, 6.30; iron oxide, 2.50.

Applying the formula we have

Silica, 21.14 × 2.8 = 59.19
Alumina, 6.30 × 1.1 = 6.93

Total 66.12 = calculated % lime.

The "hydraulic modulus" is 2.20.

It is evident, therefore, that the statement that this formula gives cements too high in lime, is wholly false.

In offering the foregoing suggestions on the calculation of cement mixtures, the writer will not say, as Dr. Michaelis does of his own paper "I am sure to offer wslcome assistance to many cement chemists in this country." The Dr. does not seem to realize that there are over 40 Portland cement factories in the United States, the product of which this year will be more than one half that of Germany. In point of quality, we can justly claim that there is no Portland cement made anywhere else in the world that is equal to the product of the leading American factories. American cement chemists do not need elementary instruction in chemical arithmetic, nor in rules of manufacture taken from books of a generation ago. On the other hand, suggestions based upon practical experience and careful experiments are greatly needed, and such will always be welcomed by all who have at heart the progress of industry and science.

S. B. NEWBERRY.

Sandusky, Ohio, Sept. 17, 1900.

MICHIGAN'S PORTLAND CEMENT INDUSTRY.

The state of Michigan is rapidly forging to the front in the manufacture of Portland cement. Nearly every section of the Lower Peninsula is represented by plants either in operation or projected—at Bronson, Burr Oak, Quincy, Coldwater, Mosherville, Montgomery, Hillsdale, Woodstock, Brooklyn, Three Rivers, Battle Creek, Union City, Kalamazoo, Wayland, Grand Rapids, Muskegon, Newago, Fremont, Baldwin, Elk Rapids, Alpena, Holly, Fenton, and other points. The product is said to be equal to the best imported article. The productions of the mills already is sufficient to offset the entire importation.

As soon as the mills projected at lake points get in operation the low water rates in connection with the reduced prices will enable them to command the entire seaboard trade. Detroit is the center of interest in these enterprises. The securities of perhaps twenty or more projected manufacturers are now being offered on there. As usual, sharpers are on hand with various schemes, and are offering securities in corporations capitalized for large sums and making great claims. Despite these rotten schemes, the Portland cement business is immensely profitable, and Michigan alone will be in position within the next two years to supply the entire demand of the United States.—*Exchange.*

MONIER CYLINDERS AND PILE COVERS.

(From *Indian Engineering*, June 23, 1900.

Cockle Creek bridge in New South Wales is worthy of notice by reason of the use there of cylinders built on the Monier system instead of cast iron (whereby a saving of 264 pounds, 5 shillings was effected on two small piers alone), and of Monier coverings to protect the timber piles from the attacks of the "cobra" (insect). The system, which is fully described below, and illustrated by the plate, is very efficient and capable of extended use.

This bridge (see plan), though not of importance in point of magnitude, being only 343 feet in length, and costing 3,800 pounds, is of considerable interest, owing to the use in its construction of Monier cylinders in lieu of cast iron, and also Monier pipes as a protective covering for the piles. The difficulty of protecting timber piers in salt water from the attacks of the "cobra" leads to the use of the cylinders, generally of cast iron filled with concrete, for important piers such as those under truss spans, and the cost of the cast iron cylinders has been a very serious item. The success of the Monier system in connection with pipes of all sizes suggested that it might be used as a substitute of cast iron in cylinders, and it was tried for the first time at Cockle Creek, as now described.

The main piers of the bridge each consist of two cylinders 3 feet 6 inches internal diameter, and $2\frac{1}{4}$ inches thick, constructed on the Monier principle, and having one layer of wire netting (1 inch mesh and 16 gauge), and two spirals of 10 gauge steel wire wound completely round the cylinder, the turns being 1 inch apart. The longitudinal connection is formed by six steel bars $1\frac{1}{4}$ inch by $\frac{1}{4}$ inch placed between the wire spirals; these bars are so arranged that those of adjoining lengths of cylinder can be coupled together by means of a small fishplate and steel wedges.

In sinking the cylinders the joints were made with red lead to prevent leakage, and it was found that, when several segments were joined together, they could be lifted without disturbing the joint. A cast iron cutting segment was used (see Fig. 4) to protect the bottom edge of the cylinder, and as a precaution against damage by the men's picks, a thin steel plate guard was provided for the inside of the cylinder up to a height of 4 feet, but this was not found necessary. The cylinders were sunk through gravel, sand and clay, 36 to 41 feet below the water, and as it was found possible to keep them pumped dry if well pressed down by means of screw jacks, the air lock was not required. When a satisfactory foundation was reached the cylinders were filled with concrete in the usual way, the inside surface of the Monier being carefully cleaned to get as good a bond as possible with the concrete.

The cost of these cylinders, delivered at site, was 24 shillings per foot, as against 3 pounds per foot for cast iron cylinders of the usual type, making a saving of 264 pounds 5 shillings on those two small piers alone, and their is no doubt that their use in suitable localities will result in a very large saving in future.

Hitherto, where protection from the teredo has been necessary for timber piles, Muntz metal has been generally employed, or, in some cases, earthenware pipes filled with concrete; but these latter, owing to their fragile nature, and the difficulty of making a joint with the necessary longitudinal strength, have not proved very satisfactory. At Cockle Creek the experiment was made of using Monier pipes for a pile covering. These are exceedingly strong to resist fracture, and even if cracked do not fall to pieces; they can be joined so as to have a good strength longitudinally, which makes them easy to handle; and, what is most important, a series of piles can be forced down with screw jacks without danger of cracking.

Fig. 1 on plan shows the Cockle Creek bridge, in which 5 timber piers, having 3 piles in each, or 15 piles in all, have been protected by Monier pipes.

The formation is sand mixed with vegetable matter, overlying stiff clay to a depth of about 5 feet, and it was considered desirable that the piles should be protected down to the point where they entered the clay, so as to provide against removal by scour of the soft upper strata. The piles were of ironbark, about 40 feet long, 14 inches diameter at the small and 18 inches diameter at the large end, driven 15 feet into the clay. From the level of the clay to high water, 4 hardwood battens were spiked to act as guides for the pipes, and the piles received a coating of Stockholm tar before driving. Driving having been completed, a small platform was attached to the pile above high water, and upon this were erected, by threading, over the head of the pile, a sufficient length of 21-inch diameter Monier pipes to reach from high water to the clay bed. The pipes were then joined with a wire netting cover and cement, the joint being the ordinary Monier pipe joint, swelling the diameter of the pipe about 2 inches; but it may be mentioned that the contractors for the pipes have made an improved joint (shown in Fig. 2), which will suit better and be more sightly. While the joints were setting the cap valves were fixed on to the piles, so as to bring them into position, and avoid movement after the pipes were sunk. The platform was then removed, and the pipe casing lowered by means of hooks under the bottom length of the pipe, until it rested upon the bottom. A jet of water from an inch and a half pipe was then worked round the bottom of the pipe casing to loosen the material, and pressure was applied by means of screw jacks at the top, when the casing sank easily to the clay bottom. The space between the casing and the pile having then been scoured out with the jet, was filled with clean sand, finished with 9 inches of concrete at the top to form a cap. The casing presents a neat appearance, and no doubt will prove of great durability, probably outlasting the pile.

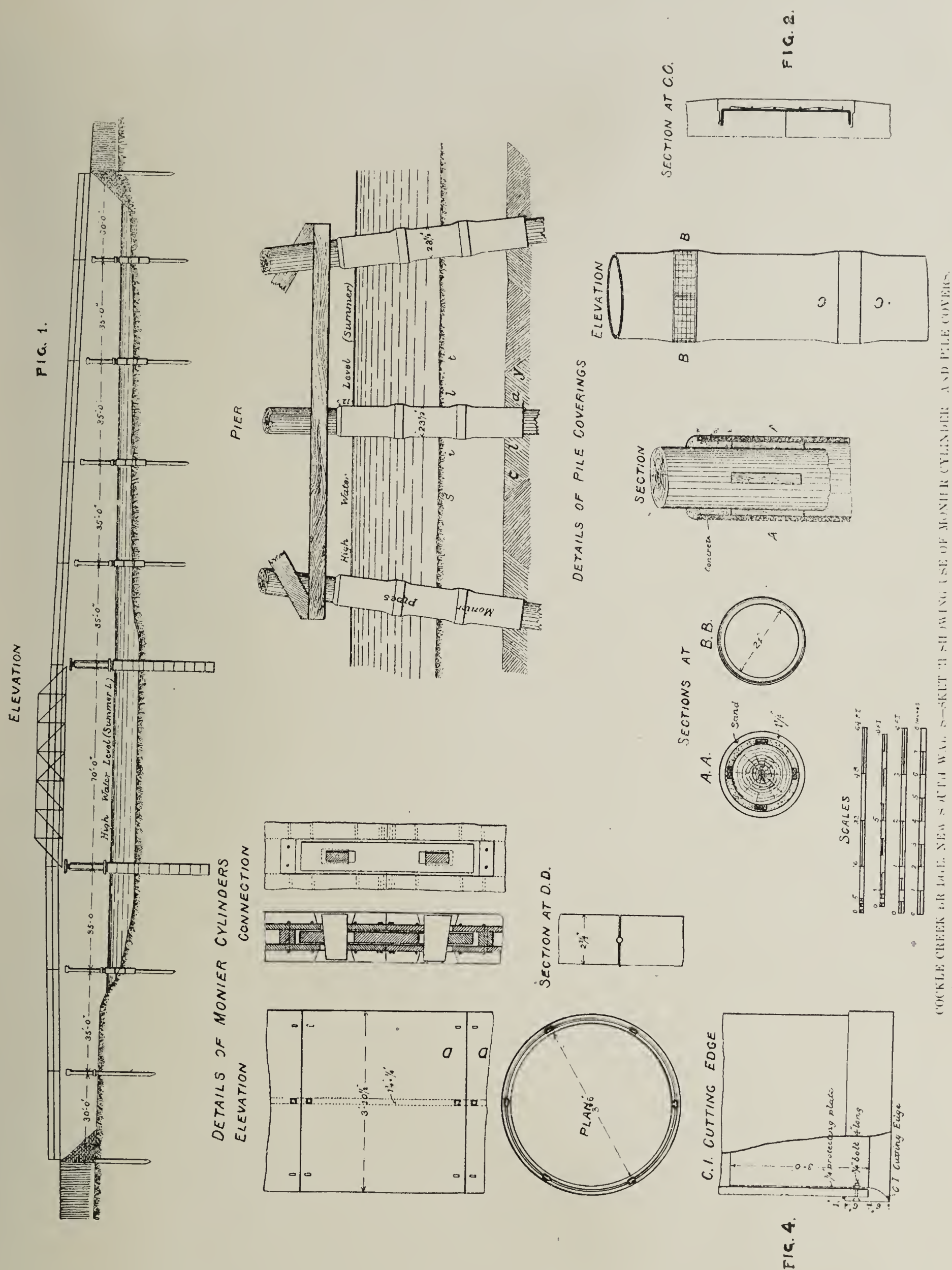
The pipes used are constructed on the usual Monier principle, being $1\frac{1}{4}$ inch thick, of cement mortar on a groundwork of wire netting, $1\frac{1}{4}$ inch mesh and 16 gauge.

The Elk Rapids Portland Cement Co. of Elk Rapids, Mich., expects to start up in October.

Samuel C. Jones, president of the Newark Lime and Cement Company, died at his home, East Orange, N. J., Sept. 19th, after an illness of five days. He was eighty-one years old and up to his last illness was in good health, and his death was a surprise to his many friends.

The Louisville Cement Company is now making 5,000 barrels of cement a day, the largest output for many years. The Black Diamond Mill, near Cementville, Ind., was started up a few days ago and the mills on the falls are running full time. The cement company has all of its mills in operation now for the first time in three years. The demand is good, indicating activity in the building trades throughout the country.

The Chinese are assuming control of the building industry in the Hawaiian Islands. Eighty per cent of the building permits issued in Honolulu since January 1st have been taken out by Chinese contractors, who operate sash and door mills, deal in lumber and brick, which they import, as there is no brick made in the islands. These contractors likewise employ Chinese stone masons, carpenters, and plumbers who are fast displacing white labor in these special lines.



COCKLE CREEK BRIDGE, NEW SOUTH WALES—SKETCH SHOWING USE OF MONIER CYLINDERS AND PILE COVERS.

FACTS CONCERNING THE USE OF STEEL IN CEMENT CONCRETE CONSTRUCTION.

By F. Melber, Engineer, Pittsburg, Pa.

The combined use of steel bars, or rods, with cement concrete or mortar for buildings, bridges and constructions of innumerable kinds is bound to become general, because of the great economy, strength and ease of adaptation in the field of engineering and architecture. The good features and possibilities mentioned are recognized by many and, in a more or less bulky way, steel and concrete have been jointly used and are now used in foundations, floors and divers other work. We know however, and some express their surprise of the fact, in pamphlets, circular, books, etc., that the progress, considering the great advantages offered, of a more free and general introduction and adoption of this mode of building, is comparatively very slow. In this connection I venture to say that there is, after all, a very good and sufficient reason for this, for, on hand of what has been hitherto known and offered, the engineers and architects cannot see their way clear as to the safety of their construction, for which they are held responsible.

No amount of talk about wonderful tests and experiments (the bad and indifferent ones are never mentioned) will in the least assist in dispersing doubts. When designing, or rather previous to it, the engineer and architect calculate the dimensions and sections of their steel or timber girders, posts, trusses, etc., and, without the shade of a doubt, find as a result the safe load their beam, post, etc., will carry, or the load under which it will break down. They don't need to wait till tests or experiments would tell them that. How about such construction in steel and cement combined? Can the professional man go about his problems in the same way, or, indeed, do even tests and experiments give him what he is otherwise unable to find?

Right here is the cause of obstruction to progress and where relief is needed. Investigation discloses the fact that neither the Monier nor the other systems, hitherto known and cited, can furnish such relief. For I find, as far as the most searching and untiring efforts of the patent office could discover in this and other countries and as far as I could survey the field since the building up of my system, that none of the others can furnish a key to the situation which is thus explained. I therefore concluded to call attention to the remedy my system offers on hand, of which strains, strength and safety can be computed in the same manner as for steel structures. I incorporate these two main characteristics in my system: First—Steel and concrete or mortar stretch the same amount, or contract the same amount, when under strain. Second—The steel is proportioned so as to meet the intensity of the resultants of inner shearing and tension strains and is placed at calculated points of action of said resultants.

With these conditions fulfilled, all uncertainty vanishes; there will be no more reason to test steel and cement structures than there is to test steel structures. The cement, of course, will, at all times be tested as to quality for the same reason as the steel is tested in the mill for quality.

SPECIFICATIONS FOR MOSAIC TILE FLOORS.

The base or sub-floor for the concrete must not be less than 4 ins. below the finished floor. Where it is of wood, the boards are to be spaced to allow for swelling, and protected from moisture and drying of the concrete by a double layer of tar paper; dampen the base when it is brick, terra cotta or earth, to prevent its robbing the concrete of water.

The concrete is to be mixed dry, one part Portland cement, with respectively two parts sharp sand, five parts clear gravel; or one part sharp sand, six parts coal cinders; or two parts sharp sand, three parts broken stone, moistened not to exceed the dampness of molding sand, spread in even layers, which are rammed to utmost compactness, until it is raised to within $1\frac{1}{4}$ ins. of the finished floor line. The concrete must be left perfectly level, protected from grease and building debris, particularly lime and plaster.

Setting of the tile should be begun within a day after the concrete is laid, or if this be impossible the concrete must be thoroughly saturated with water to prevent its drying the cement mortar. Mix dry two parts Portland cement with three parts clean, sharp sand, and add no more water than needed to make a very stiff mortar, which must be used fresh, and thrown away if it has gotten an initial set before using. In no case mix the lime with the mortar except in setting tile to the perpendicular walls, and then not to exceed 10 per cent.

Spread the mortar evenly, with great care, to establish the level of the floor for the tile, without excessive pounding. Set the tile with ample joints of at least $\frac{1}{16}$ of an inch and fill or grour these with clear Portland cement from the surface mixed with water to the consistency of cream. Wash off all cement from the surface of the tile before it sets, and clean the floor by mechanical means. If acid must be used for the removal of cement stains, dilute and apply it with a brush to a small space at a time only, and wipe it up immediately with clear water, to keep from cutting out the joints. Protect the floors from use for five days.

STEVENS LITHOLITE STONE.

F. W. Morgan of Morgan & Wright Co. is erecting a concrete mansion, to cost $50,000, on his 1,000-acre farm near Beloit, Wis. The entire building, walls, roof, floor and partitions will be of concrete, with trimmings of litholite stone. Ten litholite columns form part of the design, each made in one piece 19 ft. long by 2 ft. 4 ins. at the base, cast on the ground only a few feet from the building in which they occupy so prominent a feature.

The Owen Sound Portland Cement Co. are operating the Stevens Patent Litholite Stone in Ontario and will erect the buildings for their newly projected Portland cement mill entirely of litholite stone. The Stevens & Ringer Co. of Harvey, Ill., a suburb of Chicago, have more orders in Chicago than they can fill this season and are turning away new orders almost daily. Litholite is an artificial Portland cement stone manufactured by an entirely new process.

THE McKELVEY CONCRETE MIXER HIGHLY RECOMMENDED.

FALLS CITY ARTIFICIAL STONE CO.
Louisville, Ky., Sept. 25, 1900.

McKELVEY CONCRETE MACHINERY CO.,
Chicago, Ill.

Gentlemen—The concrete mixer purchased has given such satisfaction that we deem it an injustice should we not recommend it for what advantage we have gained through it. It has given us entire satisfaction, not only on large contracts but on small ones with equal results. Since using your mixer we have had no trouble in having our work accepted, we remain,

Yours very truly,
Falls City Artificial Stone Co.,
By A. S. Robertson, Pres.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the Cement and Engineering News.

ENGLAND.

CEMENT SHIPPED FROM PORT OF LONDON, AUG., 1900.

TO	TONS	TO	TONS
Adelaide	4	Halifax	6
Aden	3	Harlingen	36
Alexandria	514	Hongkong	34
Amsterdam	108	Jamaica	168
Auckland	258	Las Palmas (Arg.)	27
Azores	3	Lisbon	38
Baltimore	54	Lyttleton	462
Beunos Ayres	911	Madeira	17
Bangkok	18	Madras	247
Bautoum	18	Malta	50
Beira	223	Melbourne	338
Bermuda	105	Montevideo	331
Boca	394	Montreal	1,375
Bombay	327	Newport News	1,155
Boston	196	New York	74
Cadiz	300	Penang	534
Calcutta	934	Pt. Elizabeth	913
Cape Colony	2,656	Rangoon	95
Coatzacoates	275	Rio Janeiro	168
Channel Isles	309	Rosario	170
Chinde	4	Rotterdam	252
Christchurch	9	Sangon	1
Cochin	96	San Juan	16
Cologne	7	Santos	771
Colombo	783	Singapore	28
Constantinopie	90	St. John, N. B	156
Demerara	292	Surinam	54
Durban	614	Sydney	336
East London	581	Trinam	27
Fremantle	857	Trinidad	793
Gibraiiton	3	Vancouver Isle	18
Gibraltar	2,030	Varna	13
Grenada	72	Vera Cruz	233
Guildford	18	Wellington	488

CEMENT IMPORTED INTO THE UNITED KINGDOM.
July, 1900.

FROM	TO	TONS.	£
Antwerp	London	354	507
"	Liverpool	219	330
"	Bristol	125	278
"	Hull	303	551
"	Llanellry	207	392
"	Middlesboro	130	194
"	Newcastle	215	424
"	Plymouth	127	185
"	Sunderland	280	430
"	Glasgow	2,274	6,820
"	Grangemouth	283	497
"	Leith	10	12
Boulogne	London	110	143
Bremen	"	180	300
Caen	Newhaven	4	10
Calais	Leith	240	300
Cologne	Grangemouth	450	835
Copenhagen	London	6 cwt.	8
"	Hull	2 cwt.	1
Ghent	London	219	330
"	Liverpool	404	900
"	Goole	56	111
"	Hull	1,067	1,217
"	Manchester	630	942
"	Plymouth	130	130
"	Swansea	20	54
"	Leith	300	375
Hamburg	"	25	60
New York	Liverpool	1	4
Rotterdam	London	8	45
"	Aberdeen	562	1,144
"	Dundee	101	202

EXPORT OF CEMENT (IN TONS) FROM BELGIUM.

TO	JULY	JAN.-JULY.		
	1900	1900	1899	1898
Germany	297	2,372	2,365	2,935
Great Britain	8,339	43,322	49,052	28,760
Australasia	768	2,148	5,277	2,261
Brazil	2,113	13,621	13,233	14,029
Canada	2,735	9,801	6,656	14,074
Cape Colony	427	2,275	3,663	2,376
Chili	188	564	678	813
China	359	1,922	2,758	4,520
Cuba and Porto Rica	248	2,337	3,912	286
Egypt	69	6,195	9,383	5,430
Spain	1,144	4,273	4,848	2,202
Congo Free State	200	935	834	653
United States	13,382	78,407	58,836	74,089
France	629	7,221	5,646	5,403
British East Indies	845	4,628	4,644	4,162
Japan	8	23	584	4,464
Mexico	77	2,438	2,312	1,330
Natal	367	1,518	4,803	2,062
Norway	617	4,404	6,803	2,704
Holland	3,823	27,202	23,589	22,700
Portugal	783	3,596	3,276	2,089
Argentine	910	16,468	23,340	15,878
Roumania	.....	128	1,300	909
Russia	51	628	1,299	1,048
Turkey	12	62	281	353
Uruguay	62	333	424	466
All others	1,076	8,047	8,669	6,742
Total (kils.)	.....	244881	248,479	222,751
July only	39,542	.....	44,977	36,389
Full years	.....	.....	445,602	419,131

UNITED KINGDOM.

EXPORT OF CEMENT IN TONS.

TO	AUGUST.		JAN.-AUGUST.	
	1899	1900	1899	1900
Holland	399	352	2,770	2,957
United States	508	1,263	18,624	32,157
Brazil	1,451	1,075	10,784	7,314
Argentine Republic	1,407	1,530	10,397	12,503
British South Africa	3,459	4,333	28,416	30,208
British East Indies	2,012	3,181	27,357	30,562
Australasia	2,254	2,873	23,427	22,387
Canada	1,352	6,018	9,294	24,094
All others	10,038	8,151	100,861	113,646
Totals	22,880	28,776	231,930	275,828

Exports of cement for August, 1898, were 23,705 tons; from January to August, 1898, 226,108 tons.

IMPORT OF CEMENT INTO UNITED KINGDOM, 1900.

MONTHS.	TONS.	VALUE £
January	3,934	8,082
February	7,018	14,857
March	5,401	12,213
April	7,918	17,694
May	9,820	21,115
June	9,139	20,262
July	9,439	18,806
August	9,080	18,588

GERMANY.

EXPORT OF CEMENT IN TONS.

TO	JULY.		JAN.-JULY.	
	1899	1900	1899	1900
Freeport, Hamburg	1,219	1,543	4,679	9,779
Belgium	506	691	3,558	2,874
Denmark	632	1,338	5,514	5,962
Great Britain	12	648	1,813	3,106
Holland	3,261	4,804	22,912	29,652
Norway	2,298	1,519	10,372	8,659
Austria	2,155	2,586	11,932	12,411
Russia	3,665	1,939	16,072	9,730
Finland	1,417	974	4,443	4,886
Switzerland	1,114	701	7,169	4,332
Cape Colony	2,619	1,883	4,861	5,344
Transvaal	617	170	4,639	1,106
China	4,263	1	17,876	3,433
Dutch East Indies	817	958	5,946	7,365
Argentine	143	1	4,787	6,207
Brazil	827	1,020	8,967	11,363
British North America	992	900	2,801	3,299
Chili	697	406	5,384	4,980
United States	20,203	13,881	121,208	141,081
Australasia	2,284	3,351	19,772	20,858
Totals, with others	53,216	44,375	301,030	324,500
1898	48,469	.....	289,695	.....
1897	50,392	.....	277,987	.....

The Birmingham Cement Company's works at Ensley, Ala., is being rebuilt.

The Dickinson Cement Co. of Chicago is delivering 10,000 bbls. of Marquette Portland cement to the United States government under three separate contracts.

The Detroit Portland Cement Co. has filed a mortgage with the register of deeds at Flint, Mich., for $400,000, running to the Atlantic Trust Company of New York, to secure the payment of bonds issued to buy marl lands, erect cement works and provide capital to operate the same.

The Garden City Sand Co. of Chicago has issued for circulation a handsome pamphlet giving the inside facts about Chicago A.A. cement, wherein numerous contractors testify to the uniform good properties of the A.A. cement in all kinds of mason work and especially for sidewalk and curb and gutter construction.

The Jeffrey Manufacturing Company of Columbus, Ohio, was awarded a gold medal at the Paris Exposition covering its line of Elevating, Conveying and Mining Machinery. No doubt many of our readers who have enjoyed a visit abroad this summer have had the pleasure of seeing the exhibit of this company.

A mortgage for $650,000 given by the Egyptian Portland Cement Co. to the Union Trust Co. of Detroit has been recorded at the office of the register of deeds at Flint, Mich. The mortgage covers marl lands in Genesee, Oakland, Shiawassee and Livingston counties, and secures bonds that bear interest at 7 per cent and run until 1910.

The Smith Premier Typewriter received greatest number of points for superiority at the Paris Exposition and was awarded a Diploma of the Grand Prix for its superiority of construction and efficiency at the Highest Rating of the Jury. This Grand Prix was won by the Smith Premier in competition with twenty other typewriters on exhibition.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	JULY.				SEVEN MONTHS ENDING JULY.			
	1899.		1900.		1899.		1900.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom	1,513,800	5,763	3,949,190	14,867	33,726,585	125,603	52,087,187	202,623
Belgium	17,848 901	55,244	15,138,248	41,508	125,131,886	379,306	170,446,375	491,938
France	1,200	4	8,073,420	27,784	2,832,800	9,743	10,828,272	39,207
Germany	31,659,100	109,387	8,019,756	55,948	233,089,968	822,428	237,107,140	935,863
All Other Europe	1,468,420	5,902	3,653,571	12,229	13,725,487	28,784	19,511,033	66,001
British North Am.	157,625	741	262,500	1,614	1,057,875	4,779	865,550	4,623
Other Countries	7,602	136	240,000	1,011	9,600	145	4,622,060	20,983
TOTAL	52,656,648	177,177	39,336,685	154,997	409,574,201	1,370,788	495,467,617	1,761,238
Domestic Exports of Cements, bbls.	7,375	15,047	3,385	7,213	54,058	109,235	45,033	98,490

There were 655,622 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on July 31, 1899, valued at $1,541, against 8,421,813 lbs., valued at $28,978 in July, 1900.

Imports of asphaltum or bitumen for July, 1899, were 14,933 tons valued at $43,956; July, 1900—11,482 tons valued at $33,172. For seven months ending July, 1899, 53,845 tons valued at $174,068; for seven months ending July, 1900—56,388 tons valued at $207,486.

A company has been formed in Copenhagen to export chalk to the United States to be used in the manufacture of cement, to take return cargoes of American coal which is assumed can be sold in Denmark in competition with English coal at much lower prices.—*N. Y. Journal of Commerce.*

The *Engineering News* of New York designates Porto Rico as a manufacturing point for Portland cement on the strength of the United States government's consumption of 30,000 bbls. per year on the island. Cement can be manufactured in the United States and shipped to Porto Rico to greater advantage than it can be manufactured on the island. Besides a 30,000 bbl. plant would never pay in competion with our product.

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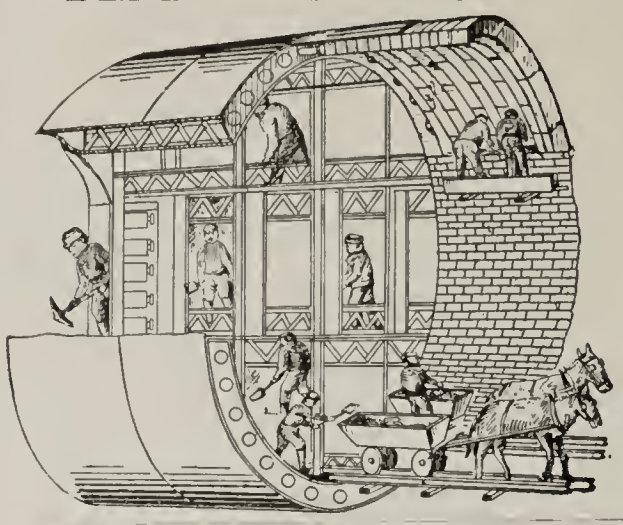

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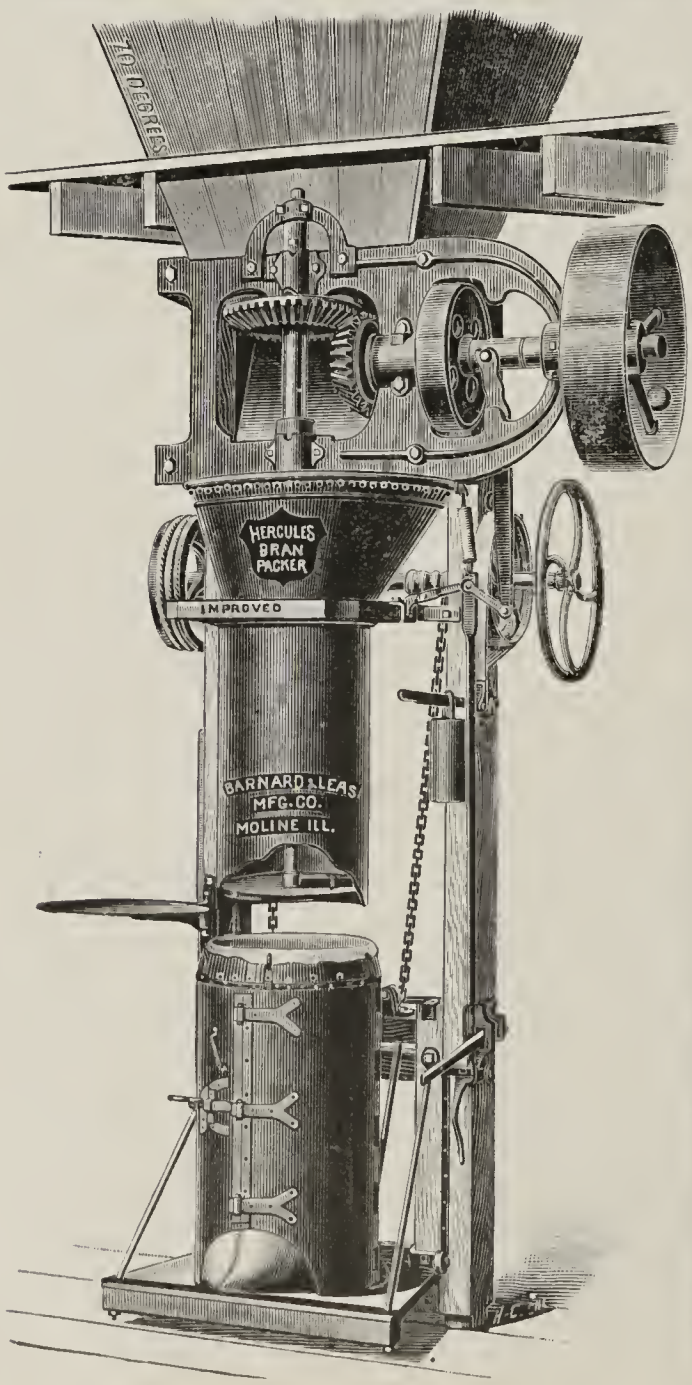

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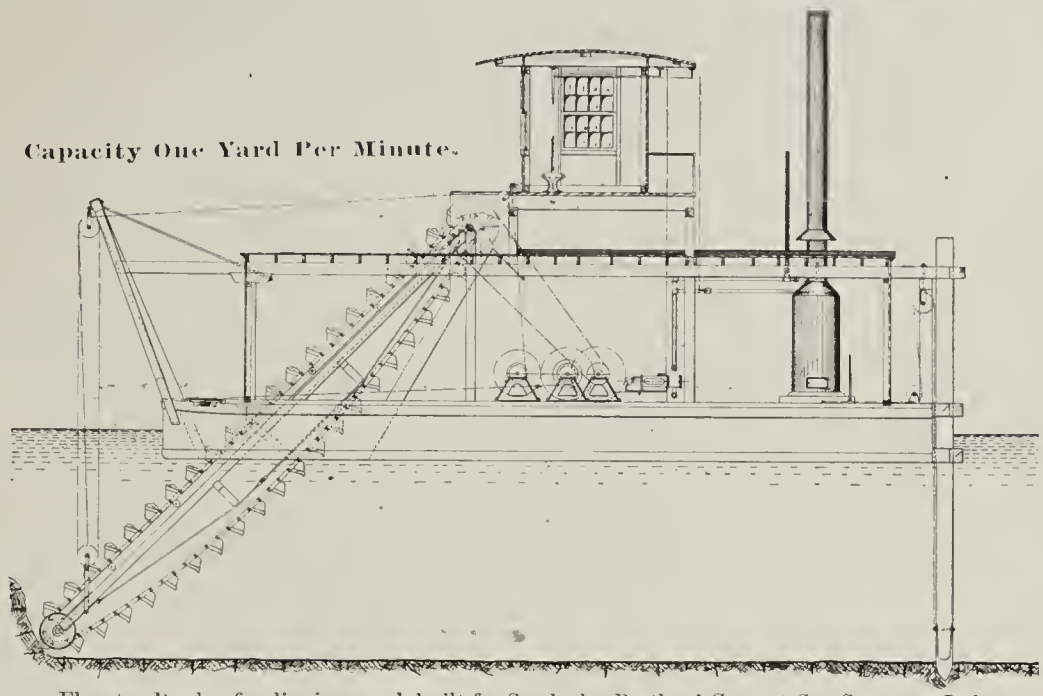

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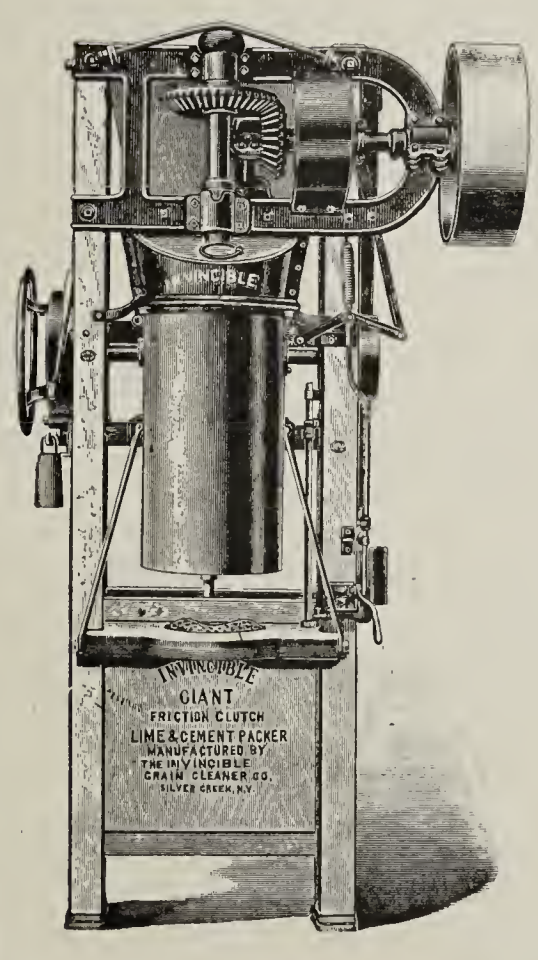

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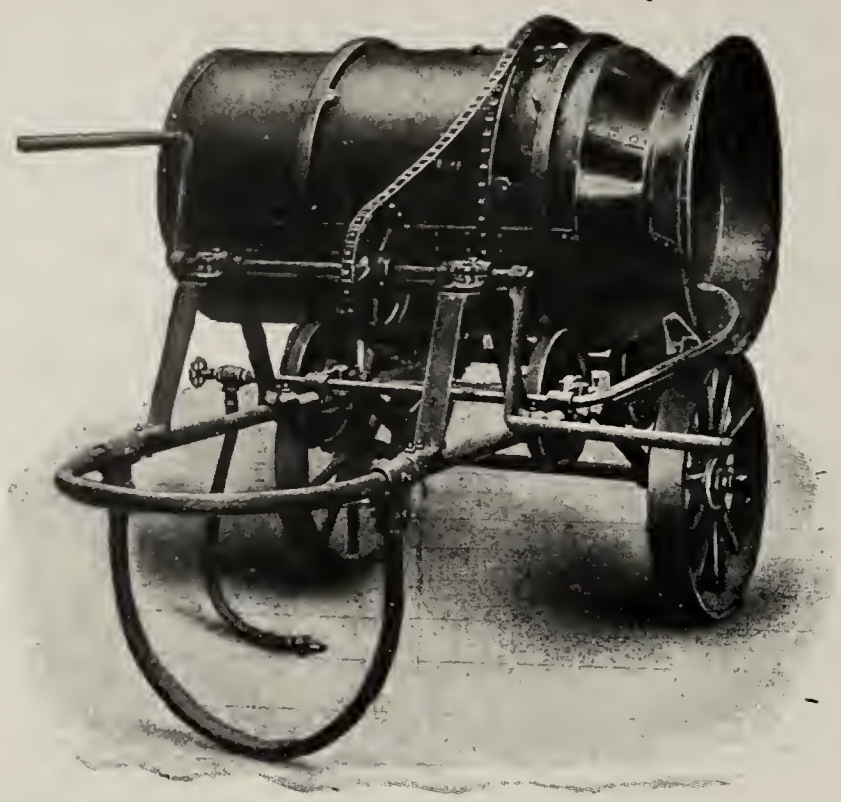

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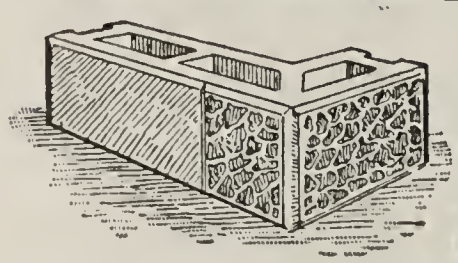

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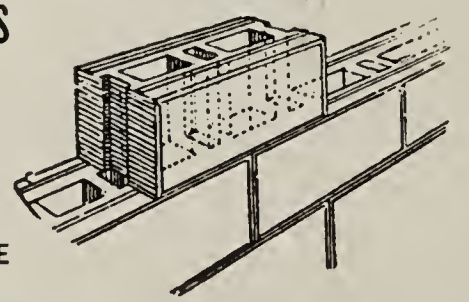

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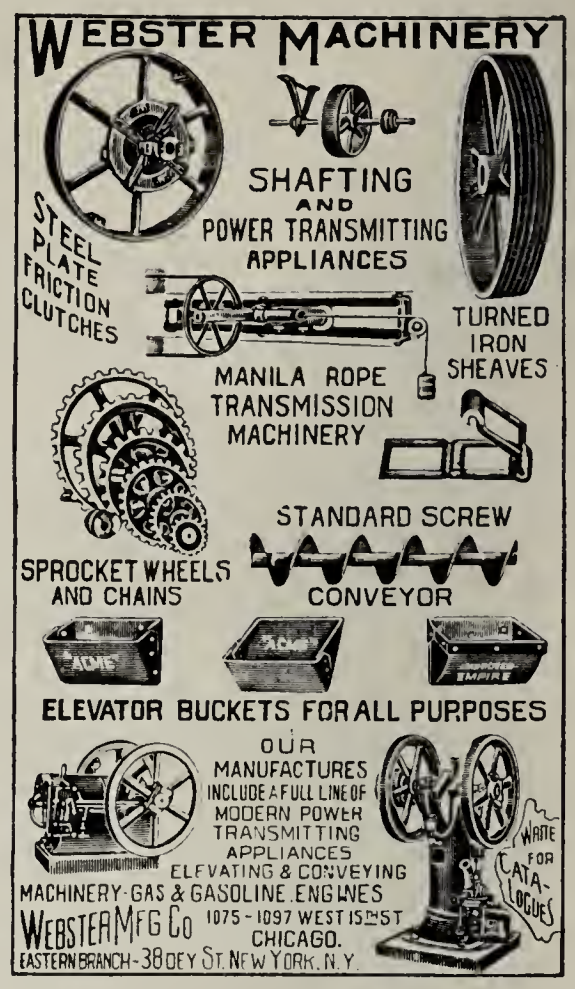

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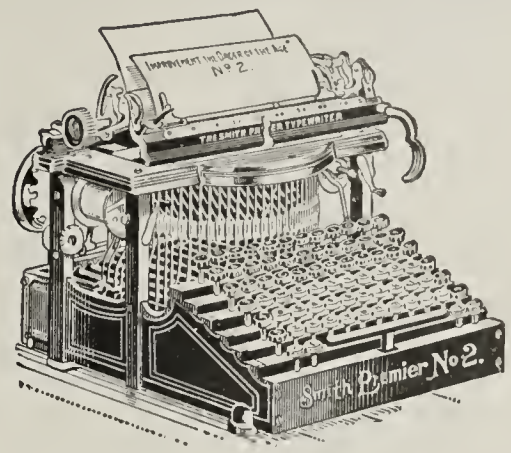

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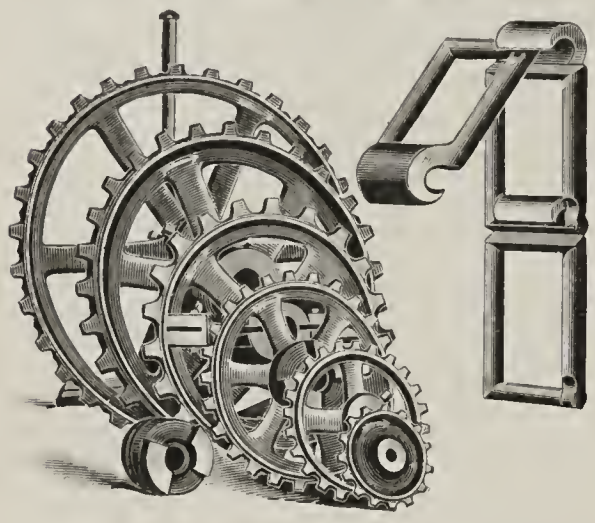

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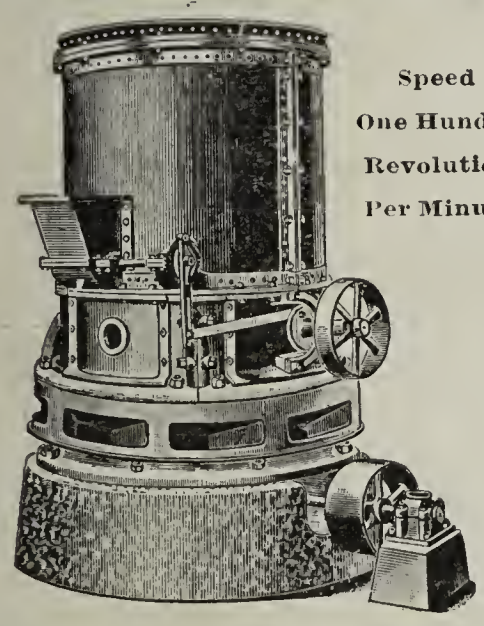

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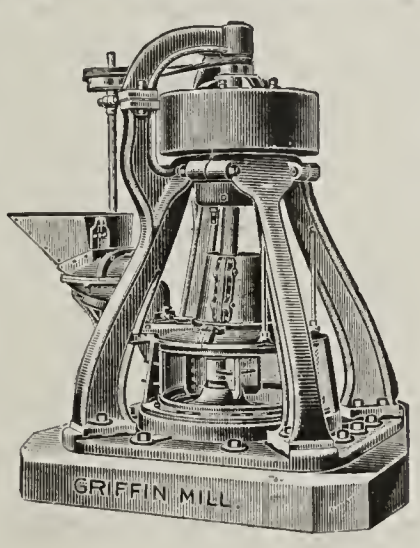

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CONCRETE FACTORY BUILDING OF MESSRS. SAUTTER-HARLE & CO., PARIS, FRANCE.

This building is constructed entirely of Portland cement mortar, with inlaid steel wires and shapes. The illustration shows the machine and erecting shop only. The entire building covers one-half acre of ground. The concrete girders supporting the roof show a very high state of constructive design in concrete materials. The illustration and data are from *La Revue Technique.*

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher.

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

LARGE AND SMALL CEMENT PLANTS.

The prevailing high prices of Portland cement during the past two years have attracted millions of capital to engage in its manufacture in the United States. A survey of the field reveals one hundred plants organized in the United States and Canada. Many of these organizations exist on paper only, yet are ready and willing so sell stock on future speculative values. There are now over sixty plants in being, or under construction, to compete for the home cement trade which, in 1901, will produce about 10,000,000 barrels of Portland cement, against about 6,000,000 barrels produced in 1899. The decline in prices in the early spring season has forced several small plants to grind at a very low margin or at a loss, the economy of output being clearly with the large plants. They can produce at a profit even where the prices obtained are no higher than the exact first cost of manufacture to the small mill owner.

The Portland cement mill of the future must be sustained by abundant capital and have a large daily output. Actual experience has demonstrated the fact that the cost of manufacture is reduced directly in the ratio as the capacity of the plant is increased. Such a plant must have been carefully planned for an economical output by competent engineers of the highest standing and strictly on the American system of manufacture and be operated by trained experts. The fixed charges for expert service distributed over the output of the large plant will be less per barrel of cement produced than with the smaller mills. This will apply as well to the other departments of the plant. It is, therefore, entirely safe to assume that the large plants are the ones that will really control the business in the future. The same facts and reasoning are equally true applied to European mills.

By consulting the dividend tables of the German mills for 1899 (given in another column in this issue) it will be seen that the large plants are sweeping in the big dividends; therefore, except at points remote from the great centers of consumption, the small cement plant must be considered as a thing of the past and beyond resurrection as a legitimate enterprise.

The ideal Portland cement mill of the future, to secure the greatest economy of output, in our opinion, should have a daily capacity of 3,000 barrels per day and upward.

CEMENT IN SOUTH AFRICA.

No country is a better customer for cement than South Africa. All public buildings, warehouses, stores and residences are built of brick, cemented on the outside. No wood, or frame houses are seen. The expert Malays, the masons in this country, are adepts in producing very pleasing effects with cement in the outside finish of buildings. The bricks used in South Africa are two-sevenths larger than the American bricks and are "laid up" principally with "mud," the inferior clay found here, instead of mortar (lime) or cement. Over the whole surface, cement is laid. Bricks of different shapes form the window sills, caps, columns, pilasters, moldings, etc., and over these is spread the cement, forming a very pleasing exterior, the natural stone being closely imitated. Many of the large buildings are "spattered" with the cement, presenting a rough exterior very striking, and even durable. I know of no cities that have more handsome and unique building exteriors than the cities of this colony. Cement is also used in making drain pipes, sidewalks, stoops, tiles, chimney pots or tops. Brick exteriors are never seen, as the bricks are inferior, the best qualities being made of clay and coal cinders.

Of the cement imports for 1899, amounting to 126,672,875 lbs., Belgium furnished 18,423,628 lbs.; Germany, 7,448,395 lbs.; other countries, 605 lbs.; and the United Kingdom the balance. During 1900 the imports of cement from Germany have been increasing rapidly, as it has been found that German cement is equally as good as the best English Portland and can be bought at 1s. (24 cents) per barrel cheaper. Belgian cement is good and sells at 18d. (36 cents) cheaper than the English.

When I left the United States, our manufacturers of cement were producing an article which was proved by tests to be as good as the English, and that cement ought to find a large market here. While the United States, at the present time, would be hampered on account of the excessive steamship rates to this country, which would prevent competition with the German and Belgian cements, yet I am convinced, with equal rates, the United States cement could find a market here in large quantities. Cement of the desired quality will never be manufactured here, as the ingredients do not exist.

J. G. STOWE,
Consul-General.

CAPE TOWN, Sept. 17, 1900.

The Caledonia Cement Works, near Tweed, Ont., were destroyed by fire in September, thereby throwing 100 men out of employment.

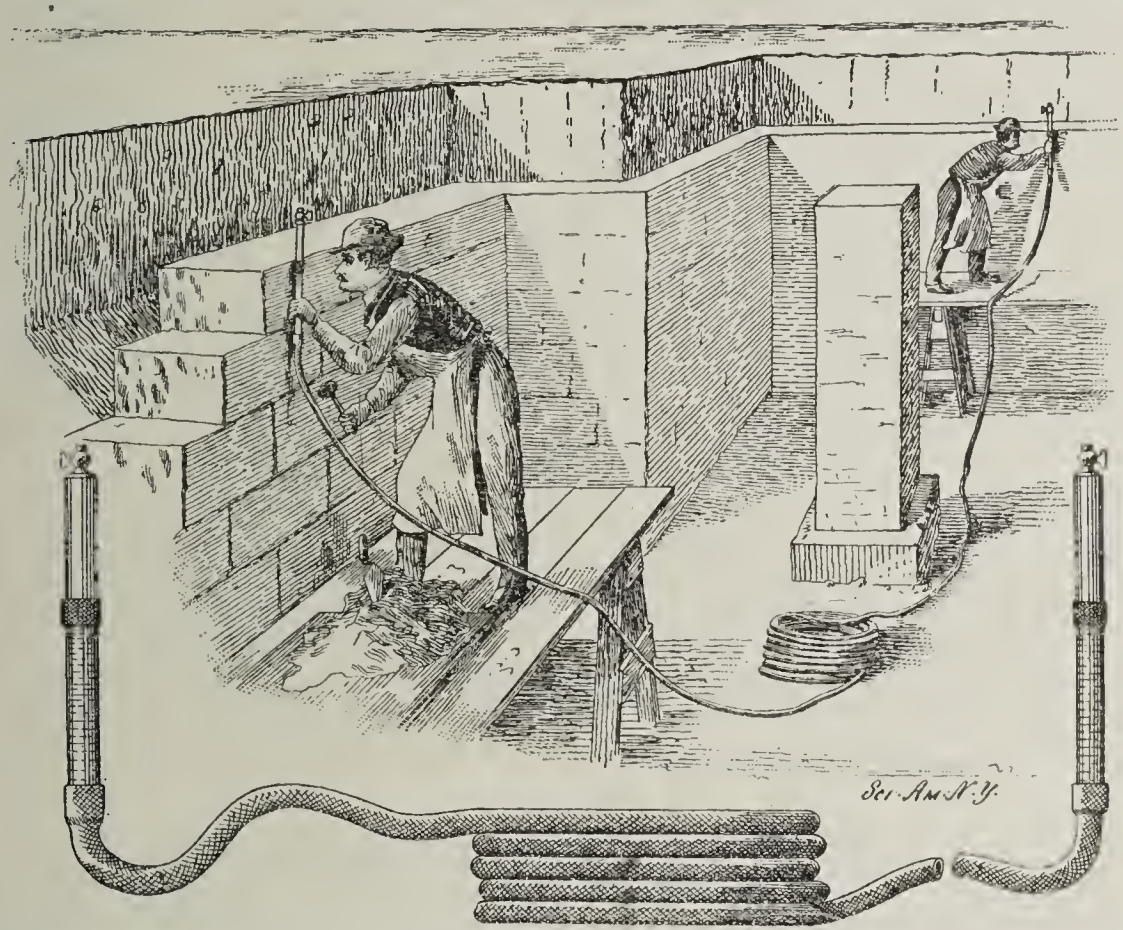
John W. Smith of Muncie, Ind., is interesting Coldwater, Mich., capitalists in a new Portland cement plant, to be located at Coldwater.

F. L. Smidth & Co., 66 Maiden Lane, New York, have issued a 20-page pamphlet describing the principle of tubemill grinding, under the following heads: Construction, speed, foundation, fineness, uniformity of output, repairs and lining, followed by a description of flint balls, with half-tone illustrations of the fields where they are gathered, and the trade mark under which the highest grades are marketed. The Smidth Ballmill is fully described and illustrated. A list of American Portland cement mills in which the ball and tube mills are in use is also given. The pamphlet gives much valuable information that will be useful to cement manufacturers. To be had on request.

APPLICATION OF THE HYDROSTATIC LEVEL IN BUILDING CONSTRUCTION.

By Owen B. Maginnis.

The science of modern building construction necessitates the introduction of such instruments, tools, and appliances as will expedite the work and lessen expense by economizing time. Such an implement is the hydrostatic or water level, shown in the accompanying drawing. The instruments most popular for leveling in laying out large works are the engineer's transit, theodolite or architect's Y level, all of which are of the utmost utility for mechanical operations. However, the form of improvised water level shown in our engravis, perhaps, most adaptable, as it can be easily and cheaply made, is accurate in its action and simple in its application. As will be seen, it consists of a long piece of ribbed rubber hose or pipe, half an inch internal diameter, with pieces of transparent glass tubing, 12 or 18 ins. long, inserted in each end. These glass tubes should, if obtainable, be graduated into inches and parts of inches down to sixteenths, but if graduated tubes are not to be had, smooth tubes of clear, thick glass of chemical tubing will do, and a quarter or half-inch section can be cut off the end of the rubber pipe and set over the glass tubes, which will slide up or down so as to form a gage.



Water is poured into the rubber hose pipe and glass tubes till the ends overflow, when they are kept full by placing a small tip or faucet at the ends of the tubes, as shown. When in use, the faucets must be opened in order to allow the water to find its own level. One glass tube is placed against the wall which has been built to the required height, being held firmly against the face of the wall with the gage set 4, 6 or 8 inches from the top as desired, the gage being kept at the edge of the brick or stone wall templet, from which the required level is to be measured. Here it is held by one man, while another carries the other glass tube to the object to be measured. When the water is exactly on the line of the gage the level point is determined, and the distance of the detail above or below the gage will denote the discrepancy in the relative heights. This will be readily understood from the engraving, where this simple instrument is represented in use as setting the levels on top of a foundation wall for templets for iron beams, or in a position where the transit or Y level and staff would not be so convenient or so applicable. Many masons use this instrument with a rod for finding depths of trenches for walls, piers, etc., for leveling for templets, sills, water tables or other details, especially in an excavation which is crowded with piers, shores, derricks or appliances, which, of course, render the use of the transit or Y level impossible.—*Scientific American.*

The Great Northern Portland Cement Co. has 300 men at work for the past two months at Baldwin, Mich., in clearing the mill site and putting in foundations for a 4,000-bbl. plant. The erection of the structural steel will commence about December 1. The company hopes to have the principal buildings enclosed February 1, 1901, when the installation of the machinery will begin, which will be of the most modern design.

LOUISVILLE CEMENT MARKET.

(From Our Special Correspondent.)

Louisville, Oct. 19, 1900.

The cement market is in better shape than it has been for some months, though the improvement has been so gradual that exciting features have been wiped out. The shipments of both Louisville and Portland cement, particularly the former, have been steadily improving and have covered the entire South, particularly the states of Kentucky, Tennessee, the Carolinas, West Virginia, Georgia and Alabama, from which sections come daily reports of the erection of new cotton and woolen mills, banks and other mercantile construction requiring the use of cement. The demand is heavy enough at the present time to seriously embarrass dealers by reason of car shortage, the orders accumulating. Another feature of the disposal of cement shipped from this market is the use made of it for street improvement in the South. The South, up to a short time ago, was content to allow stock and wagon wheels to keep her dirt streets in order, but a tendency is now shown to correct this evil by building macadamized or asphalt streets with a solid concrete foundation. This applies not only to the larger cities but to many of the smaller towns as well. Louisville is possessed of thirteen mills, which are all running at full capacity, the smaller ones on the falls being actuated not only by a wholesome demand, but also a fear of high water before a winter stock is in, to blast and grind with diligence. The mills north of Jeffersonville and New Albany, are likewise running full capacity. The combined capacity of the Louisville mills is estimated at 15,000 bbls. per day. The market quotations on cement as given by the *Evening Post* and reviewed daily have been unchanged for some months, the prices ranging on Portland from $2.90 to $3.35 per bbl. and on Louisville from 58 to 75 cents per bbl., bags being quoted at 52 cents, with bags returnable at 5 cents each. The outlook for excellent fall and winter business is good, the future demand from an architectural source alone being encouraging.

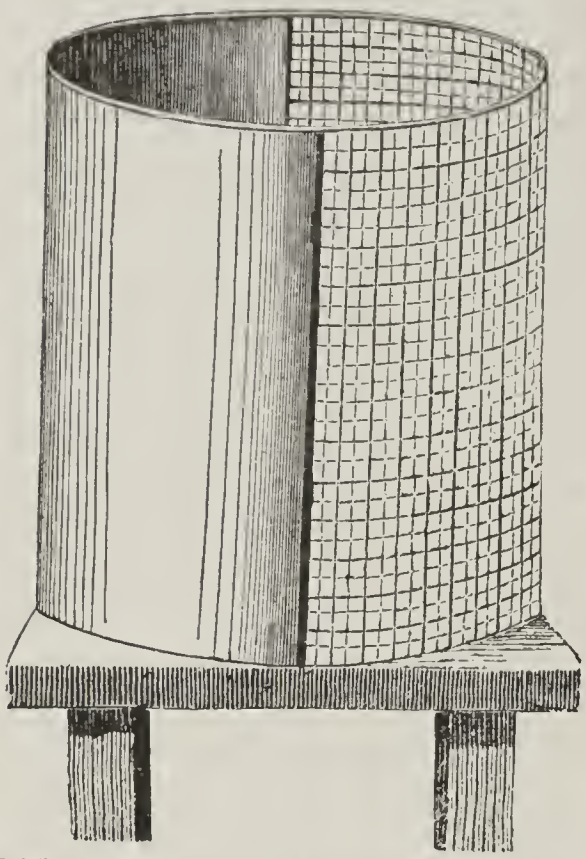
H. L. M.

A director of the American Cement Company says that the gross sales for September were about 8 per cent in advance of the same month last year. He also says that from 400 to 500 bbls. a day are being shipped on the New York rapid transit tunnel contract. No new orders of any size are being taken now, as this is not the season for placing large orders.

THE MONIER EXHIBITION AT THE PARIS EXPOSITION OF 1900.

(Extracts from *Le Ciment* by E. LEE HEIDENREICH.)

The exhibit of fortified concrete construction by the Society for Cement Constructions (the old firm of J. Monier Fils, whose name will always be inseparably connected with the invention of fortified cement con-



Exhibit, Monier Tank Construction, Paris Exposition.

structions) is very picturesque, and has a certain artistic character which forms one of the exhibits most admired in class 28 by the numerous visitors to the exhibition. The exhibit shows very aptly fortified cement constructions in their different applications. There are models for columns, capitals, balustrades, vases, etc., all executed with a great purity of alignment and forming an artificial stone of such solidity and strength that it may be employed under the most exacting circumstances. Furthermore we find several types of pipes and flumes in fortified cement for hydraulic work under pressure, which system has been adopted by the sanitary department of Paris, and a number of photographic views are shown of the manufacturing of conduits from 50 to 40 centimeters diameter for water distribution under high pressure. We further find some types of sewer pipe, which are built directly in the trenches, and also reservoirs built in the same manner. Our illustration covers several forms showing details of construction.

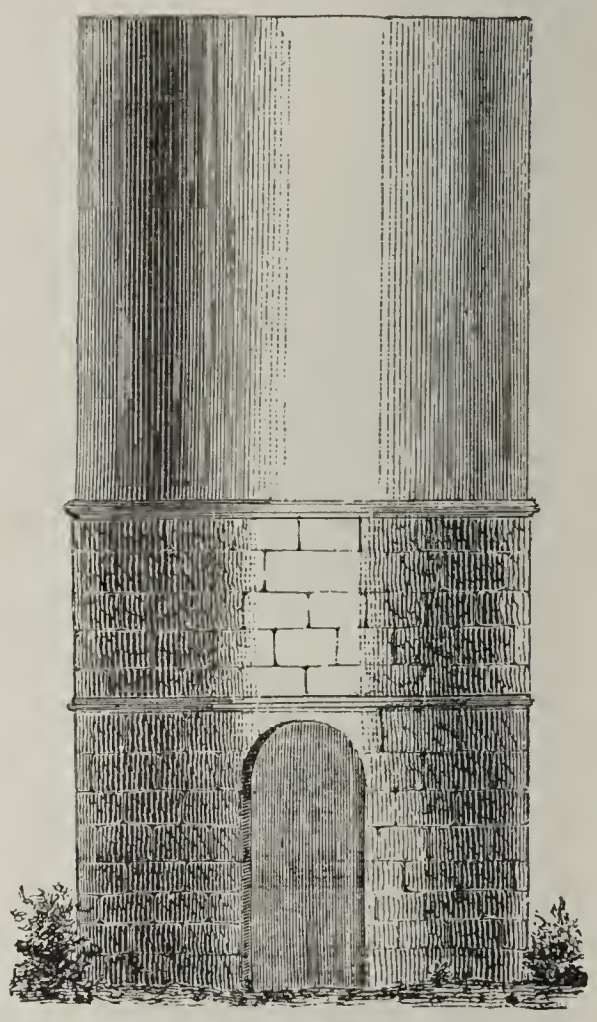
The exhibition also shows a very decorative department for parks and gardens. There are grottos built of artificial rocks surmounted by a kiosque and bridge, branches of trees and other objects imitating parts of a natural forest in a most striking manner. Finally the construction of the grand circular stairway at Pavillon du Cambodge and all the interior and exterior rustic decoration of this pavillion, which is certainly one of the most interesting of the colonial expositions. We cannot enumerate the varieties of work executed by this society for cement construction and we will merely add that their system, for which they have exclusive rights, has been adopted by the cities of Paris and Aix and several municipalities, also by the administration of buildings and highways, army and navy of France, the firm of Felix Potin for their wine reservoirs, etc.

This society makes a specialty of the following items:

First—Stationery and portable reservoirs for water and acids for laundry, paint shops, tanneries, distilleries, gas plants, water works, etc.

Second—Conduits for water and gas with and without internal and external pressure; conduits for electric wires and cables, drainage and hydraulic purposes; sanitary equipment, sewer pipe, closets, etc. Continuous floors and stone flags for factories, warehouses, courts, sidewalks, etc. Girders or beams, stairways, and last, but not least, for the construction of grain elevator storage tanks. We have before mentioned the decorations for parks and gardens which can be varied ad infinitum.

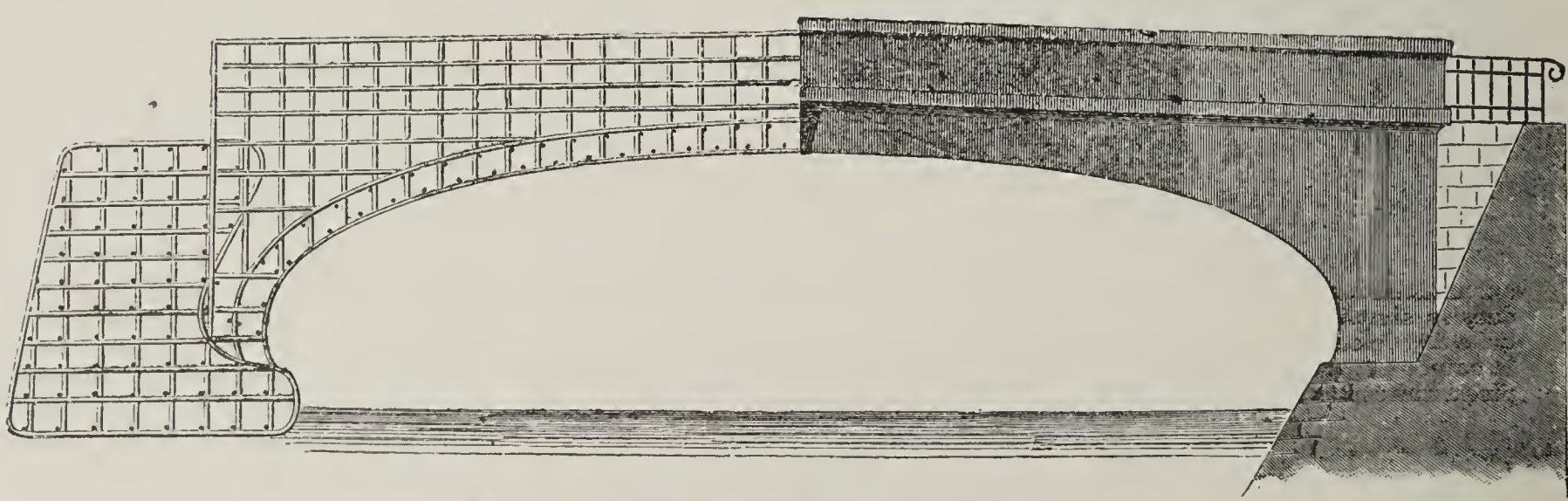
In connection with the above, it may be of interest to know that Messrs. Sautter-Harle & Co., the well-known manufacturers of electrical machines, have constructed their entire factory in fortified cement or an adaptation of Monier construction. The accompanying cut shows their machine shop, where



Monier Tank and Base.

columns, girders, floors, beams and walls are built of cement mortar with inlaid steel strengthening shapes.

C. W. Stevens, patentee of the Litholite Stone Co., has gone to Europe in the interests of his foreign patents.



Monier Concrete Arch Bridge Exhibit, Paris Universal Exposition.

The Omega Portland Cement Co., Jonesville, Mich., is circulating a 15-page pamphlet among cement consumers, under the title "How to Use Portland Cement." It is illustrated with half-tone plates of the works, describes briefly how Portland cement is made by them. It also describes cement mortar, concrete sidewalk, curb and gutter construction.

THE UNITED STATES PORTLAND CEMENT COMPANY.

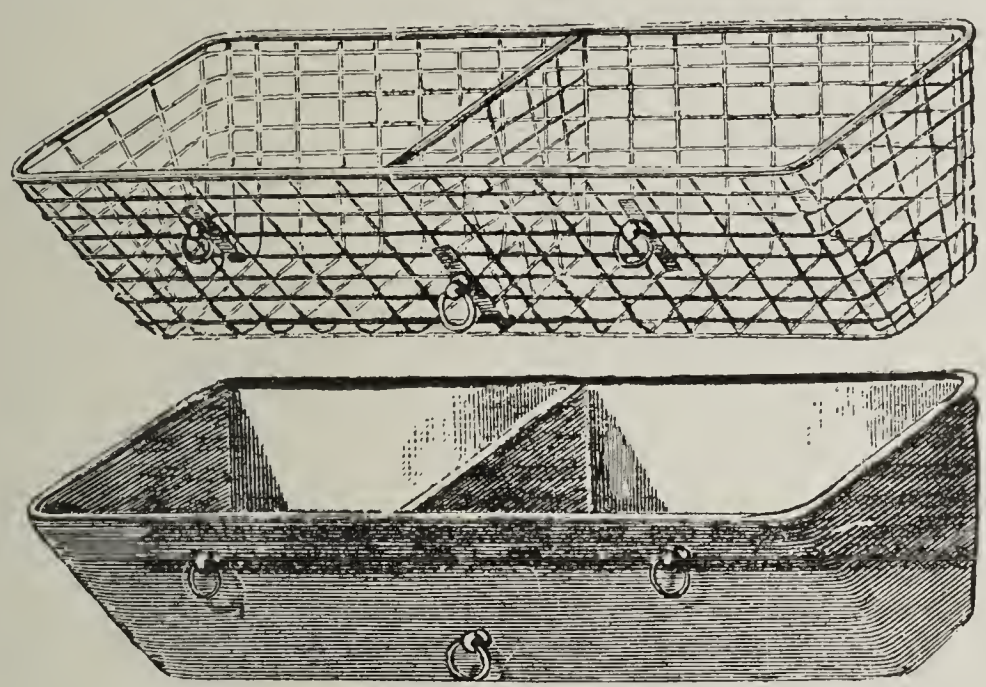
An important movement, looking to the amalgamation of the American Portland cement industry is under way. The recent incorporation of the United States Portland Cement Company, with a capital of $12,000,000, has this object in view. Mr. Sheldon H. Bassett of New York is at the head of the company, and, on account of his intimate knowledge of the cement business, and his own personal high standing, has been able to interest with him in this enterprise some or the strongest people in the country. England and Germany have already perfected organizations on identical lines.

It has been apparent for some time to all who are in a position to know the facts, that the time is peculiarly right for the formation of a cement combination in the United States, which will at once insure reasonable prices to the consumer and a fair profit to the manufacturer. On account of the high price of steel, the Presidential election and the great strikes, there has been a temporary lull in important construction work, and the Portland cement mills have suddenly found themselves with a surplus stock of cement, which has had the effect of causing many factories to offer their surplus production at a much lower figure. We are, therefore, glad to note that there is to be a Portland cement amalgamation, and that it has fallen into such capable hands to put the enterprise through. Already the United States Portland cement company has effected arrangements with some of the most important mills in the country, having a capacity of over a million and a quarter bbls. per year. We do not understand that it is the purpose of the United States company to take in all of the cement factories, but only such as have demonstrated their ability to make the highest grade of Portland cement at the lowest possible cost.

We are informed that an important feature of the plans of the United States Company is to establish warehouses in the principal commercial centers which will enable the company to constantly have on hand at the different trade centers a sufficient quantity of the highest grade of Portland cement to meet requirements and always make prompt delivery.

The CEMENT AND ENGINEERING NEWS is interested in seeing the Portland cement industry established and maintained on a basis which is as advantageous to consumer as to manufacturer.

We have recognized the tendency to overdo the business in certain sections in the construction of small plants. Such a course, if persevered in, can only result in bringing disaster to investor and manufacturer alike.



CEMENT TROUGH.—(MONIER CONSTRUCTION.)

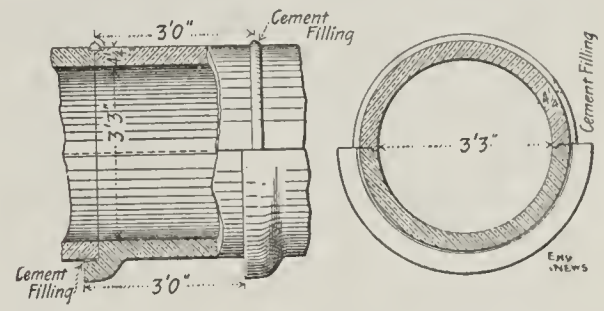
THIRTY-NINE-INCH CONCRETE PIPE SEWER AT COOKSTOWN, IRELAND.

A length of 1,854 ft. of 39-in. concrete sewer was recently built at Cookstown, Ireland, with Mr. Henry Shillington as engineer. From a somewhat lengthy illustrated description of this work, published in the London *Surveyor* for May 25, 1900, we have prepared a brief description giving the most essential facts.

The sewer or culvert was an extension of a brick sewer of the same interior diameter, built to enclose a stream into which the sewage of the town is discharged. The location of the sewer being principally in either a "very shifty, sandy stratum, or else through rock-bed (principally the former)." Mr. Shillington decided to use a concrete pipe in two sections, as shown by the accompanying illustration. It will be seen that the lower section has flanged hub and socket joints, while the upper section has butt joints, with provisions for cement calking in the lower and a bond of cement in the upper section. Longitudinally there is a tongue and rebate joint.

The sections were made in 3-ft. lengths, net, on molds covered with zinc sheeting. This covering gave rise to the greatest difficulties encountered in the work since:

A very slight shrinkage of the wood, joined with the hard rubbing on the concrete which seemed to extend the



metal, resulted in buckling into perceptibly longitudinal ribs, so that the sheets had to be periodically lifted and adjusted. Of about 1,400 sections made only five were broken, two of which were repaired.

At the start an outer as well as an inner mold was used, but the outer mold was dispensed with and the coucrete placed on the mold designed to form the inner surface, "as dry as possible and hammered tightly as the work procceeded."

As to the cost of the work, Mr. Shillington has the following to say:

The cost of making has not been quite £1 per lin. yd., and the total cost, laying and all included, will not be quite 30s. per lin. yd. Had it been done in earthenware pipes, I estimate it at about 55s. per lin. yd. In brick work in cement it is difficult to say what it would have been, owing to the well-known character of the ground passed through, i. e., shifty, sandy soil.

According to these figures the cost of making and laying was about $2.30 per lin. ft.

In our issue of Oct. 21, 1891, we published designs for concrete sewer pipe, made on somewhat similar plans as this, but of different cross-section, patents for which were then controlled by the Waring Sewer Pipe Co., of Newport, R. I. We do not know to what extent, if any, the company introduced the pipe. Cement pipe sewers of various shapes and sizes have been made in this country for years past, and concrete sewers have been constructed in the trench, notably at Reading, Pa., and elsewhere under the Ransome system.—*Engineering News.*

A Portland cement plant is under consideration at Rushsylvania, O.

CONTRA NEWBERRY.

By Dr. W. Michaelis, Jr.

My paper "How to Calculate the Proper Cement Raw Mixture From the Given Raw Materials" published in the August issue of this magazine has been attacked by Mr. Newberry with more than impolite words. Mr. Newberry tried "to call attention to certain erroneous and unjust statements which the paper contains" and went in his uncouth expressions so far as to assert that "there is scarcely a word of truth" in the following paragraph, which I take pleasure to repeat once more:

"Recently American chemists" (that is to say Newberry Bros.) "tried to repeat Le Chatelier's experiments. Unfortunately they worked under quite different conditions, at a far higher temperature and leaving out of view the fact, that at different temperatures different compounds out of silica, lime and alumina may be formed. Therefore the results of these experiments are without use for practice. Le Chatelier's formula gave the limits of the proportions on both sides as save as they are asked for by the limits of the hydraulic modulus 1.8 to 2.2. The new American formula, worked out at temperatures, where higher limed cements can easily be obtained, yields in practical application cements with a too high hydraulic modulus, it is of no use because one-sided."

One generally does not make such assertions without having thoroughly examined the matter and repeated the tests, which formed the basis for the other party's statements.

I wrote my article because I had obtained the experience that, in many cases, Newberry's formula yielded an over-limed cement, whereas with the same raw materials the application of the hydraulic modulus 2 was found to yield very satisfactory results.

Those who have worked with materials similar to those which formed the basis for Newberry's formula, will have noticed how much higher temperatures those tests need than is customary in the ordinary cement burning, and, therefore, Mr. Newberry will not make anyone who has investigated this matter believe his statement that his experiments were not carried on at temperatures higher than those reached in ordinary cement manufacture. Instead of having written: "there is scarcely a word of truth" in the recited paragraph, he ought to have written: "I neglected to measure the temperatures and am quite unable to state the exact temperatures applied."

If he describes now, in his reply to my paper, that he makes his test burns in a test kiln with coke or gas and natural draft; this is quite right so far as ordinary Portland cement is concerned. But the tests described in his original paper have been made out of white cement mixtures, that is to say out of silica, alumina and lime, without iron. A Fletcher gas furnace was used for vitrifying those materials and "the heat was varied to suit the material, an intense white heat being easily obtained with sufficient blast pressure."

The question of the temperature required is the point which I attacked in Mr. Newberry's experiments and which I will prove hereafter, in order to show that Mr. Newberry is much mistaken in denying my statement that his experiments were carried on at a far higher temperature than the ordinary burning temperature, or that he is unjust, in case he knows himself how far his experiments were removed from the plane of ordinary cement burning, to deny my statement with the only purpose to contradict.

I have made many experiments with silica, alumina and lime and with kaolin and carbonate of lime with a view to obtain a white Portland cement. In making these tests I went a step farther than Mr. Newberry and examined not only what combinations of the raw materials would yield a good Portland cement, but I studied carefully—and this is the more important task—how far these tests differ from the burning of ordinary Portland cement. That white Portland cement can be obtained, is without doubt. But it cannot be obtained in our ordinary cement kilns because the temperature of these kilns is not high enough. The results of these experiments were briefly described by the writer in a paper on "White Portland Cement" [Cement and Engineering News, Vol. IX No. 1] and it was shown that under the best conditions the ordinary burning temperature, 1400 centigrade, had to be surpassed by 150 centigrade in order to vitrify the material.

Another experience obtained while experimenting at so high temperatures was the fact, that high limed cements can easily be obtained at these high temperatures and that, on the contrary, the rules applicable for temperatures of 1500 to 1600 centigrade are no longer applicable for the ordinary burning temperature, 1400 degrees.

Those, who have made experiments with cement materials, know what it means to have too much lime or too little iron in the raw mixture and, therefore, it cannot be surprising to find that so high temperatures are required in order to vitrify white cement material. With this experience in mind a reader of Messrs. Newberry's "Constitution of Hydraulic Cements" must believe that the test burns described in that paper are made by a platinum melter rather than by a cement burner. Mixtures, which nobody would try to vitrify in a test kiln with coke and natural draft, yield with Mr. Newberry "transparent slags" and "very fusible clinkers," but all "at the ordinary burning temperature" according to Mr. Newberry's last statement.

Of my experiments, above referred to, some were almost identical to Mr. Newberry's mixtures. I knew the temperatures required to vitrify them. Nevertheless I assumed the task to burn a few of Mr. Newberry's most fusible mixtures and passed them not only through a 180 but through a 200 mesh sieve. The result was the same as I expected. The most fusible of Mr. Newberry's mixtures required temperatures between 1500 to 1600 centigrade. Coke and natural draft are sufficient to vitrify ordinary cement material. A good coke fire yields about 1400 to 1450 centigrade. With charcoal and natural draft up to 1550 centigrade may be reached, and all temperatures higher than this can only be reached by artificial draft.

According to Mr. Newberry's experiments an addition of alkalies to the raw mixture is no longer of any advantage for the vitrification. Of course, where everything is vitrified, clinkered and fused so easily as at Newberry's an addition of alkalies in order to promote the fluxing is unnecessary. This statement alone shows that the experimentor has worked without taking into consideration the temperatures required.

I now give Mr. Newberry the advice to repeat his tests under measuring the temperatures and hope this will induce him to give in future time less undeliberated replies to my papers.

Incorporated: Eureka Cement Co. New York City. Capital, $10,000. Directors, Charles E. Schonneberg, William Bigelow and P. B. Hudson, New York City.

Incorporated: The American Cement and Oil Company, Chicago. Capital stock, $20,000. Manufacturing cements, oils, lubricants, etc. Incorporators, James B. Sascoinge, Louis B. Flower and John G. Heuman.

Incorporated: Graham Granitoid Co., St. Louis, Mo. General construction and contracting business. Capital, $2,000. Incorporators, H. R. Graham, H. J. Hugo, M. T. Graham, all of St. Louis; W. B. Homer, attorney, St. Louis.

CONCRETE MASONRY ON RAILROADS.

*Extracts from a committee report, by W. A. Rogers, engineer of permanent construction, Chicago, Milwaukee & St. Paul Railway, presented before the Tenth Annual Convention of the Association of Railway Superintendents of Bridges and Buildings, St. Louis, Mo., Oct. 16-18, 1900. The exact wording of the subject of the report was: "Is Concrete a Suitable and Economical Material for Bridge Piers, Abutments, and Railway Culverts and Arches?"

A list of questions covering the general subject of concrete construction was prepared and a copy mailed to each member of our association. In addition copies were sent to the chief engineer or similar officer of the more important railway lines in North America which do not have a representative in our association. Copies were also sent to several cement manufacturers and concrete contractors. The results have been very gratifying. Numerous replies have been received, the majority of them giving very complete information. These replies come from a wide territory reaching from Canada to Mexico, and from New York to California.

Have you or are you using natural or Portland cement concrete in building foundations, retaining walls, dams, culverts, bridge piers or abutments or similar structures?

Forty-two replies to this question were received. Of this number 39 use concrete masonry in building one or all of the structures named in the question. Three do not use concrete in any form. Of the 39 who use concrete in the construction of various structures, 19 use both natural and Portland cement concrete, 10 use Portland cement concrete only, 1 uses English Portland cement concrete only, 1 used Portland cement concrete once, 1 uses Portland cement concrete only in cylinder piers and in floors, 1 uses both natural and Portland cement concrete only in foundations, 1 uses natural cement only in foundations, 1 used concrete once to build pipe-culvert ends, and 4 do not specify the form of concrete used.

For what class of structures do you use natural cement concrete?

Twenty-nine replies to this question were received. Eleven of the replies were of a negative character, 7 of them stating that they do not use it at all. One states that it is not used on the Pacific coast, because imported Portland cement is cheaper than natural cement in that territy. One used natural cement concrete formerly with poor results, and has abandoned its use. Two used it formerly in footings with poor results and have also abandoned its use. Of the balance of the replies one uses it in the lower footings of structures mentioned in question No. 1 if the place is not too wet and the foundation is hard. One uses it in foundations and abutments. Another uses it in massive work on land where weight and mass are of special importance. One uses it only in foundations which are entirely buried and not likely to be disturbed. Another uses it in the foundations of buildings, bridge abutments and similar structures. Another uses it in light piers, coal dumps, and for similar purposes. One uses it in foundations only which are in water. Another uses it in foundations and in the body of any and all work where not exposed to the weather or running water. One uses it in foundations in fresh water only. Three use it in foundations only. Another uses it in foundations up to within one foot of the surface of the ground. Another uses it in structures of secondary importance such as small girder abutments, cylinder piers, small culverts in medium fills, and low retaining walls. Another uses it in foundations, back walls, and other masonry two or more feet from the weather. Another uses it in foundations where there is not much water, and where the loading is not excessive; he used it formerly for small culverts in low fills, but the results were not satisfactory. Another uses it for all classes of work where it is not subjected to too severe strains and where it is not exposed to the weather. It will be noticed that only four use natural cement concrete where it is exposed to the weather, and this seems to be the growing practice.

For what classes of structures do you use Portland cement concrete?

Thirty-three replies to this question were received. The range of uses to which Portland cement concrete is put by those replying, covers almost every class of masonry that the member of a bridge and building department is called upon to construct. It has been a difficult matter to summarize the replies to this question properly, on account of their wide range. Those replies of a general nature will be given first, and then a list of the specific uses of this material which have been especially named in the replies and the number of users in each instance. The general replies, given in each instance, by one person follow:

"All structures requiring strength, i. e., heavy piers, engine foundations, kilns, and other similar works."

"When cheaper to use it; generally in lieu of brick and rubble masonry."

In favor of using for the "network of abutments except for the bridge seats, and use it in foundations of abutments."

"Wherever great strength is required, where the strain is to be brought on the structure within a comparatively short time after the concrete is placed, and where erosion by running water containing grit in suspension is to be resisted."

"Neatwork and for one foot below ground for all classes of masonry for which stone was previously used."

"All structures of first importance where stone masonry is used."

"All exposed work in all masonry within two feet of weather."

"In any place where stone masonry would ordinarily be used."

"For all classes of work which are exposed and where strength and solidity are required."

"Contemplating using for arch and box culverts."

"For abutments and culverts where Portland cement is cheaper than natural cement on account of haul."

Below is given a list of the structures named specifically as being built of Portland cement concrete, and the number of those so stating in each instance:

Bridge piers and abutments both foundation and neatwork	17
Foundations of above only	2
Culverts	10
Arches, foundation and neatwork	6
Arches, foundations only	1
Foundations (all classes)	11
Retaining walls, foundations and neatwork	8
Retaining walls, foundations only	1
Foundations of buildings	2
Pedestals	3
Copings	2
Facing and repairing old stone masonry	3
Dams	2
Cylinder piers	2
Turn-table centers	2
Facing decaying stone ledges	2

What proportions of materials do you use in making Portland cement concrete? If you use a different proportion for different classes of work, please give that for each class?

"A wide divergence in practice is shown by the replies to this question. For a better consideration of it the committee has divided the different proportions of materials used in making Portland cement concrete into classes with reference to the proportions of sand to cement. All proportions reported having the same number of parts of sand to cement being put in the same class. Class No. 1 having 1 part of sand to 1 part of cement; Class No. 2 having 2 parts of sand to 1 of cement; Class No. 3 having 2½ parts of sand to 1 of cement; Class No. 4 having 3 parts of sand to 1 of cement; Class No. 5 having 3½ parts of sand to 1 of cement, and Class No. 6 having 4 parts of sand to 1 of cement.

Please state the process followed in mixing and placing concrete? If you use a machine for mixing, please state the kind, and say if in your opinion better results are obtained with it than may be obtained by hand mixing.

Many different methods of mixing and placing are followed, and condensed extracts from the correspondence showing the different methods follow:

"Stone, sand and cement are mixed carefully dry; then water is added by sprinkling; materials are measured in empty cement barrels; rammed with 1½ in. rammer."

"All ingredients are measured. Mortar is mixed first and then stone dumped into it, deposited in 12 in. layers, so racked back as to avoid having planes of cleavage. During hot weather the top surface of layers is kept well until set."

"Broken stone should be spread evenly and made thoroughly wet; gravel should be spread over the stone to an even thickness, and if free from sand should also be wet; dry sand should be spread evenly over the gravel to a smooth surface. Cement should be evenly spread over the sand; the combined layers should not exceed 12 ins. The materials are then to be turned with shovels, two shovelers working toward each other from one side turning, without any additional water, twice, then a third time, with water added as each shovelful is dropped, and then a fourth time. Concrete should be dumped in mass; layers not more than 6 ins. thick, rammed with rammers not to exceed 16 sq. ins. on the face nor weighing less than 15 lbs.

Four of those replying follow the methods about to be described:

"Sand and cement mixed dry; then wet; stone after being washed and wet is added to the mortar and then turned with shovels until every stone is completely covered with mortar; concrete to be put in place and rammed before it has begun to set."

"Sand and cement mixed dry on wood or sheet-iron platform with hoes or shovels; add water and work again; spread stones evenly on mortar previously spread; turn with shovels three or four times, adding necessary water meanwhile; deposit in 9-in. layers and ram."

"All parts accurately gaged; cement and sand thoroughly mixed dry and wetted; stone afterwards incorporated and the required amount of water added by sprinkling; concrete rammed with metal rammers until the water is flushed to the surface."

"Mixed principally by hand; sand and cement dry mixed; then wet; then stone added and mixed with shovels about twice."

Seven use, approximately, the following

process: "Cement and sand dry mixed, wet, and then stone added and thoroughly mixed."

"Sand and cement dry mixed; then spread on stone previously wet, and then full amount of water added, and mass turned until thoroughly mixed; rammed until water flushes to the surface."

"Sand and cement dry mixed, then added to gravel and mixed."

"Sand and cement mixed dry, spread in bed, broken stone placed on top; bed then wet by sprinkling, and rinsed thoroughly until every piece of stone is covered with mortar; tamped until water flushes to surface."

"All material to be actually measured by volume. Either hand mixed or machine mixed with machine of approved kind. For hand mixing sand and cement are dry mixed, then the entire amount of water added, and again mixed. Mortar then spread on the stone previously placed in a thin layer and wet, and mass turned until each particle of stone is surrounded by mortar. Deposited in 6-in. layers and well tamped immediately after being placed."

The variation in thickness of layers in which the concrete is deposited is from 6 ins. to 12 ins., three using 6 in. layers, two 8 in., two 9 in., one 10 in. and two 12 in.

The opinions as to machine and hand mixing of concrete are varied. Four require hand mixing and six prefer machine mixing by approved concrete mixers.

Do you prefer a dry, moderately wet, or wet mixture? By dry mixture is meant one which requires repeated ramming to bring water to the surface; by wet mixture is meant one which quakes when slightly rammed.

The opinions as to the proper practice to be followed in this respect are quite evenly divided between the advocates of the dry and of the wet mixtures. Ten prefer a dry mixture. Five prefer a moderately dry mixture. Sixteen prefer a moderately wet mixture. Four prefer a wet mixture. One qualifies his statement that he prefers a moderately dry mixture by saying that observation of large masses of wet concrete inclines to the belief that it brings entirely safe and satisfactory results. Another who prefers a moderately wet mixture describes the degree of wetness as follows: "Such a state that it will not quake under heavy ramming, but will by the addition of a very small quantity of water. Too dry is more dangerous than wet." Another who requires a dry mixture states that the amount of water used shall equal about 25 per cent of the volume of the neat cement. Another prefers a moderately dry mixture, although it is more difficult to get good results.

C. A. Nimocks of Minneapolis, Minn., is at the head of a project for erecting a Portland cement plant at Bedford, Ind.

The Egyptian Portland Cement Co. of Detroit will construct all buildings connected with its plant of Portland cement concrete, except roofs, which will be of structural steel.

The estimated cost of the new concrete docks for the United States government at Mare Island, Cal., is $1,000,000 each, as against $750,000 each for timber docks of the same dimensions.

CONSTRUCTION OF CONCRETE ROOFS.

In discussing the question of roofs formed of concrete a writer who had given the matter no little consideration expresses the opinion that with a good base few roofs are more durable and effective than one made of concrete, finished with a layer of fine Portland cement and sand. The point is made, however, that the work should be kept damp and as cool as possible for several days at least, this being accomplished in a comparatively easy manner by covering it two or three inches deep with sand and wetting the sand from time to time with water from a spray hose or from an ordinary watering can.

Cracks in concrete roofs are frequently caused by the settling of the buildings, either from natural shrinkage or from defects in the foundation. When cracks do appear, they should be filled with a mixture of Portland cement and sand. To counteract the expansion in roofs of this kind, compressible linings of wood strips should be used around the works where the flashings are usually placed, and cement skirting or flashing six inches high and one inch thick should be well-keyed into the walls with all concrete roofs, and this can well be done by raking out the mortar joints of the brick work that is to be covered and wetting the whole before the cement is applied. No other flashing will be required.

Where a concrete roof is laid on between the rafters, the timber work should be made strong, and there should be ample wood fillets well nailed to the lower edge of the rafters to hold the cross boarding on which the concrete is laid. When desired, slats or tiles may be either nailed to the concrete or bedded into it while yet in a damp state. The pitch most suitable for a concrete roof is about ⅜-inch to the foot. This is ample to carry off the water and not too much to affect the cement while being laid. Once a concrete roof is properly finished and all settling ceased the roof becomes almost everlasting, or at least it will last as long as the base on which it is constructed.

The town of Polo, Ill. is paying 20 per cent of the cost of all cement walks laid on its streets.

The Newaygo Portland Cement Co. is having considerable trouble in placing the foundation of its great water power dam on bed rock.

The Columbia Portland Cement Company is making preparations to erect a big plant at Caledonia, N. Y. Surveys and plans are now being made.

A Portland cement plant has been projected at Goshen, Ind.

The Portland cement mill at Quincy, Mich., has closed for the season.

The Helderberg Cement Co. has elected John G. Myers president and James C. Farrell, secretary.

The capital stock of the Alpena Portland Cement Company of Alpena, Mich., has been increased from $300,000 to $500,000.

Portland cement is coming into extensive use for street crossings, instead of stone, which has heretofore been the favorite material.

The Birmingham Cement Co. of Ensley, Ala., whose works were destroyed by fire some time since, are purchasing machinery for the new plant now under construction.

The Colton Cement Company of Colton, Cal., has purchased of P. T. Evans a deposit of cement-bearing rock near Perris. Eighty horses are hauling the rock to Colton, where it is made into cement.

The Lake Shore & Michigan Southern Railway is making a survey for a side track to connect the Monolith Portland Cement Company's works, at Bristol, Ind., now under construction.

Incorporated: South America Asphalt Paving Company of Philadelphia. To manufacture paving materials. Capital, $500,000. Incorporators—R. J. Wortendyke, Arthur L. Robinson, Clyde Brown.

The Arroyo Flume & Ditch Co. of Arroyo Grande, California, have expended $20,000 in constructing cement flumes. These flumes have given such excellent satisfaction that $10,000 more will be spent in extending the company's system at once.

New York capitalists filed with the Secretary of State of Delaware the certificate of incorporation for the United States Portland Cement Company. The business of the concern as described in its articles of incorporation, is to engage in manufacturing and mining. The capital is $12,500,000.

Capt. J. J. Myer, U. S. engineer at Los Angeles, Cal., has received six bids for the construction of the San Pedro breakwater near Los Angeles. The California Construction Co. of San Francisco were the lowest bidders —$2,375,546. About 2,370 cu. yds. of concrete blocks will be used on the work to protect the ends of the breakwater. The first contract for the work was let to Heldmaer & Neu of Chicago at over a million dollars less than the present figure.

ENGLAND.

CEMENT SHIPPED FROM PORT OF LONDON, AUG., 1900.

TO	TONS	TO	TONS
Adelaide	4	Halifax	6
Aden	3	Ilaiingen	36
Alexandria	514	Hongkong	34
Amsterdam	108	Jamaica	168
Auckland	258	Las Palmas (Arg.)	27
Azores	3	Lisbon	38
Baltimore	54	Lyttleton	462
Beunos Ayres	911	Madeira	17
Bangkok	18	Madras	217
Bautoum	18	Malta	50
Beira	2 3	Melbourne	338
Bermuda	105	Montevideo	331
Boca	394	Montreal	1,375
Bombay	327	Newport News	1,155
Boston	196	New York	74
Cadiz	300	Penang	534
Calcutta	934	Pt. Elizabeth	913
Cape Colony	2,656	Rangoon	95
Coatzacoates	275	Rio Janeiro	168
Channel Isles	300	Rosario	170
Chlude	4	Rotterdam	252
Christchurch	9	Sangon	1
Cochin	96	San Juan	16
Cologne	7	Santos	771
Colombo	783	Singapore	28
Constantinople	90	St. John, N. B	156
Demerara	292	Surinam	54
Durban	614	Sydney	336
East London	581	Trinam	27
Fremantle	857	Trinidad	793
Gibraliton	3	Vancouver Isle	18
Gibraltar	2,030	Varna	13
Grenada	72	Vera Cruz	233
Guildford	18	Wellington	488

CEMENT IMPORTED INTO THE UNITED KINGDOM.
July, 1900.

FROM	TO	TONS.	£
Antwerp	London	354	507
"	Liverpool	219	330
"	Bristol	125	278
"	Hull	303	551
"	Llanelly	207	392
"	Middlesboro	130	194
"	Newcastle	215	424
"	Plymouth	127	185
"	Sunderland	280	480
"	Glasgow	2,274	6,820
"	Grangemouth	283	497
"	Leith	10	12
Boulogne	London	110	143
Bremen	"	180	300
Caen	Newhaven	4	10
Calais	Leitb	240	300
Cologne	Grangemouth	450	835
Copenhagen	London	6 cwt.	8
"	Hull	2 cwt.	1
Ghent	London	219	330
"	Liverpool	404	900
"	Gooie	56	111
"	Hull	1,067	1,217
"	Manchester	630	942
"	Plymouth	130	130
"	Swansea	20	54
"	Leith	300	375
Hamburg	"	25	60
New York	Liverpool	1	4
Rotterdam	London	8	45
"	Aberdeen	562	1,144
"	Dundee	101	202

EXPORT OF CEMENT (IN TONS) FROM BELGIUM.

TO	JULY	JAN.-JULY.		
	1900	1900	1899	1898
Germany	297	2,372	2,365	2,935
Great Britain	8,339	43,322	49,052	28,760
Australasia	768	2,148	5,277	2,261
Brazil	2,113	13,621	13,23[illegible]	14,029
Canada	2,735	9,801	6,656	14,074
Cape Colony	427	2,275	3,668	2,376
Chili	188	564	678	813
China	359	1,922	2,758	4,520
Cuba and Porto Rica	248	2,387	3,912	286
Egypt	69	6,195	9,383	5,430
Spain	1,144	4,273	4,848	2,202
Congo Free State	200	935	834	653
United States	13,382	78,407	58,836	74,089
France	629	7,221	5,646	5,403
British East Indies	845	4,628	4,644	4,162
Japan	8	23	584	4,464
Mexico	77	2,458	2,312	1,330
Natal	367	1,518	4,803	2,062
Norway	617	4,404	6,803	2,704
Holland	3,823	27,202	23,589	22,700
Portugal	783	3,596	3,276	2,089
Argentine	910	16,468	23,340	15,878
Roumania	.....	128	1,300	909
Russia	51	628	1,299	1,048
Turkey	12	62	281	353
Uruguay	62	333	424	466
All others	1,076	8,047	8,669	6,742
Total (kils.)	.....	244881	248,474	222,751
July only	39,542	.....	44,977	36,389
Full years	.....	.....	445,602	419,131

UNITED KINGDOM.

EXPORT OF CEMENT IN TONS.

TO	AUGUST.		JAN.-AUGUST.	
	1899	1900	1899	1900
Holland	399	352	2,770	2,957
United States	508	1,263	18,624	32,157
Brazil	1,451	1,075	10,784	7,314
Argentine Republic	1,407	1,520	10,397	12,503
British South Africa	3,459	4,333	28,416	30,208
British East Indies	2,012	3,181	27,357	30,562
Australasia	2,254	2,873	23,427	22,387
Canada	1,352	6,018	9,294	24,094
All others	10,038	8,151	100,861	113,646
Totals	22,880	28,776	231,930	275,828

Exports of cement for August, 1898, were 23,705 tons; from January to August, 1898, 226,108 tons.

GERMANY.

EXPORT OF CEMENT IN TONS.

TO	JULY.		JAN.-JULY.	
	1899	1900	1899	1900
Freeport, Hamburg	1,219	1,543	4,679	9,779
Belgium	506	691	3,558	2,874
Denmark	632	1,338	5,514	5,962
Great Britain	12	648	1,813	3,106
Holland	3,261	4,804	22,912	29,652
Norway	2,298	1,519	10,372	8,659
Austria	2,155	2,586	11,932	12,411
Russia	3,665	1,939	16,072	9,730
Finland	1,417	974	4,443	4,886
Switzerland	1,114	701	7,169	4,332
Cape Colony	2,619	1,383	4,861	5,344
Transvaal	617	170	4,639	1,106
China	4,263	1	17,876	3,433
Dutch East Indies	817	958	5,916	7,365
Argentine	143	1	4,787	6,207
Brazil	827	1,020	8,967	11,363
British North America	992	900	2,801	3,299
Chili	697	406	5,384	4,980
United States	20,2[illegible]3	13,881	124,208	141,081
Australasia	2,284	3,351	19,772	20,858
Totals, with others	53,216	44,375	301,030	324,500
1898	48,469	.....	289,695	.....
1897	50,392	.....	277,987	.....

The Welston Cement Company has been incorporated under the laws of Michigan. Capital $150,000; paid in $32,000.

The Eureka Cement Company of New York City has been incorporated with a capital of $10,000. The incorporators are: C. E. Schonneberg, W. Biglow, and P. B. Hudson, all of New York City.

Plans and specifications are about ready for the construction of several hundred feet of concrete docks along the Milwaukeee river front at the foot of Jefferson street, Milwaukee, Wis., for Edwin H. Abbot.

GERMAN PORTLAND CEMENT MILL DIVIDENDS FOR 1899.

Adler, Deutsche Portl.-Cem.-Fabr. conv.	25	per cent.
Alsen'sche Portland-Cement-Fabriken	25	"
Breitenburger Portland-Cement-Fabr	11	"
Portland-Cement-Fabr. vorm. A. Giesel	13	"
Portland-Cement-Fabrik Hemmoor	15	"
Hoxter-Godelh. Portl.-Cement-Fabrik	12	"
Lothr. Cementwerke	14	"
Oberschlesische Portland-Cementfabr	13	"
Oppelner Portl.-Cem.-F. (Grundmann)	12	"
Saxonia, Cement	14	"
Schimischower Portl.-Cem.-u. Kalkw	11	"
Schlesische A.-G. f. Portl.-Cementfabr	17½	"
Stettin-Bredower Portland-Cementfabr	14	"
Stettin-Gristower Portl.-Cement-Fabr	12	"
"Teutonia" Misburger Portland-cementwerk in Hannover	9	"
Vorwohler Portl.-Cem	18	"
Westfalia, Portl.-Cem.-Fabr. i. Beckum	25	"
Wickkingsche Portl.-C.-F. Recklinghaus	13	"
Portland-Cementwerk Heidelberr	10	"
Portland-Cementfabrik Karlstadt	8	"
Portland-Cement-Fabrik Halle	11	"
Bremer Portl.-Cement-Fabrik Porta	4	"
Portland-Cementfabrik Gossnitz	20	"
Cementfabr. Groschowitz	17½	"
Hannoversche Portl.-Cem.-Fabr. A.-G.	25	"
A.-G. Hoxtersche Portland Cementfab	15	"
Portland-Cementfabrik vorm Heyn Gebr., A.-G., i. Luneburg	18	"
Furstenberger Porz-Fabr. (inb.-Act.)	3	"
Braunschweiger Portl-Cement-Werke in Salder	8	"
Bayer. Portl.-Cementw. Marienstein	9	"
Portland-Cement-Fabrik Hemmoor	15	"
Schwarzmeer Cem.-Fabr	40	"

J. F. Williams of the Egyptian Portland Cement Co. of Detroit, Mich., visited Chicago to close contracts for the construction of the company's plant at Silver Lake, Mich.

The rotary kiln plant installed by Messrs. Lathbury & Spackman, engineers, of Philadelphia, has been started up at the new works of the Alsen's Portland Cement Fabrik, Itzehoe, Germany. The machiney was shipped from this country and the plant is operating under the wet process, using chalk and clay, with very good results. The fuel used is pulverized coal.

Superintendent James Ditto has opened two new tunnels at the Round Top Hydraulic Cement Works, near Hancock, Md. The plant is exceptionally busy.

Newspaper reports credit the Atlas Portland Cement Company of Northampton, Pa., with an output of 15,000 bbls. of cement in twenty-four hours, and that the capacity of the plant will be increased to 20,000 bbls. per day.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	AUGUST.				EIGHT MONTHS ENDING AUGUST.			
	1899.		1900.		1899.		1900	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom	2,974,400	9,842	29,892,400	117,151	36,700,985	135,445	82,513,563	322,810
Belgium	21,945,086	63,437	28,072,178	89,117	147,076,972	442,743	198,518,553	582,221
France	1,289,600	4,659	297,621	1,[illegible]77	4,122,400	14,402	11,125,888	39,318
Germany	49,742,798	180,835	60,477,072	213,166	282,832,766	1,003,263	301,308,812	1,165,425
All Other Europe	4,768,208	15,142	4,907,1[illegible]5	13,[illegible]01	18,493,695	43,926	20,160,222	60,233
British North Am.	295,625	1,698	177,500	879	1,353,500	6,477	1,043,45[illegible]	5,502
Other Countries	.....	.....	1,806,010	7,610	9,600	145	6,427,065	28,233
TOTAL	81,015,717	275,613	125,629,936	442,504	490,589,918	1,646,401	621,097,553	2,203,742
Domestic Exports of Cements, bbls.	957,150	5,182	2,299,930	9,496	8,155,598	32,827	10,388,407	40,682

There were 694,822 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on August 31, 1899, valued at $1,695, against 18,926,136 lbs., valued at $61,339 in August, 1900.

Imports of asphaltum or bitumen for August, 1899, were 12,444 tons valued at $38,482; August, 1900—14,698 tons valued at $49,864. For eight months ending August, 1899, 66,289 tons valued at $212,550; for eight months ending August, 1900—71,086 tons valued at $257,350.

Portland Cement

Its Manufacture and Use.

By D. B. BUTLER, A. M. I. C. E.

Fellow of the Chemical Society and successor to the late Henry Faija, M. I. C. E.

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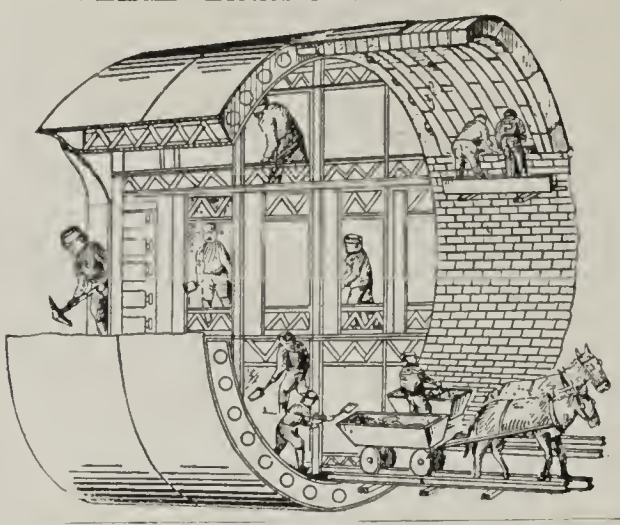

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The Joplin Cement & Coal Co. of Joplin, Mo., has been incorporated. Capital, $15,000.

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DISCOVERY OF MARL.

There has been discovered, one mile south-west from Elkhart Lake, Wis., a deposit of material which, on analysis turns out to be marl, and parties have requested Mr. Luis Jackson, Industrial Commissioner, Chicago, Milwaukee & St. Paul Railway, Chicago, to endeavor to secure a Portland cement works for the place. The deposit is said to extend over an area of 5,000 acres.

C. W. Stevens has organized a company of $50,000 capital to manufacture litholite stone at North Harvey, Ill. The stone will be sold in the Chicago market. Almost the entire stock has been subscribed by the citizens of Harvey. Thos. Moulding, president, Chicago, Ill.

Work has been started on the first of the three large plants of 1,500 bbls. capacity each, to be erected near West Camp-on-the-Hudson River in New York state, by the Alsen's American Portland Cement Works, which is the American branch of the Alsen's Portland Cement Fabrik of Hamburg, Germany. These plants are to be fully equipped with electric power transmission, and the raw materials used will be limestone and clay, burning the cement in rotary kilns by the dry process. The engineers for the plant are Messrs. Lathbury & Spackman, Philadelphia, Pa.

HAND POWER CONCRETE MIXING MACHINERY.

GILBERT H. SCRIBNER, JR.,
GENERAL CONTRACTOR
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CHICAGO, Oct. 12, 1900.

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In regard to the McKelvey Concrete Mixer which I have been using for the last sixty days under two different foremen, I have this to say, that with a poor gang of men you get a very satisfactory result, which you could not get in any other way, by its use. With a good gang of men and the machine properly operated, you make quite a saving in your labor and get a good result. I am very glad that I have one of your mixers and hope to put several more in operation next season.

Yours truly,
G. H. SCRIBNER, JR.

Operations were commenced on October 1st for the erection of the building of the Detroit Portland Cement Co., at Fenton, Mich. Foundations are nearly all in and the buildings will be under cover by January 1. The contracts for most of the machinery for this plant have been let. This plant is being designed and erected by Lathbury & Spackman, engineers, of Philadelphia.

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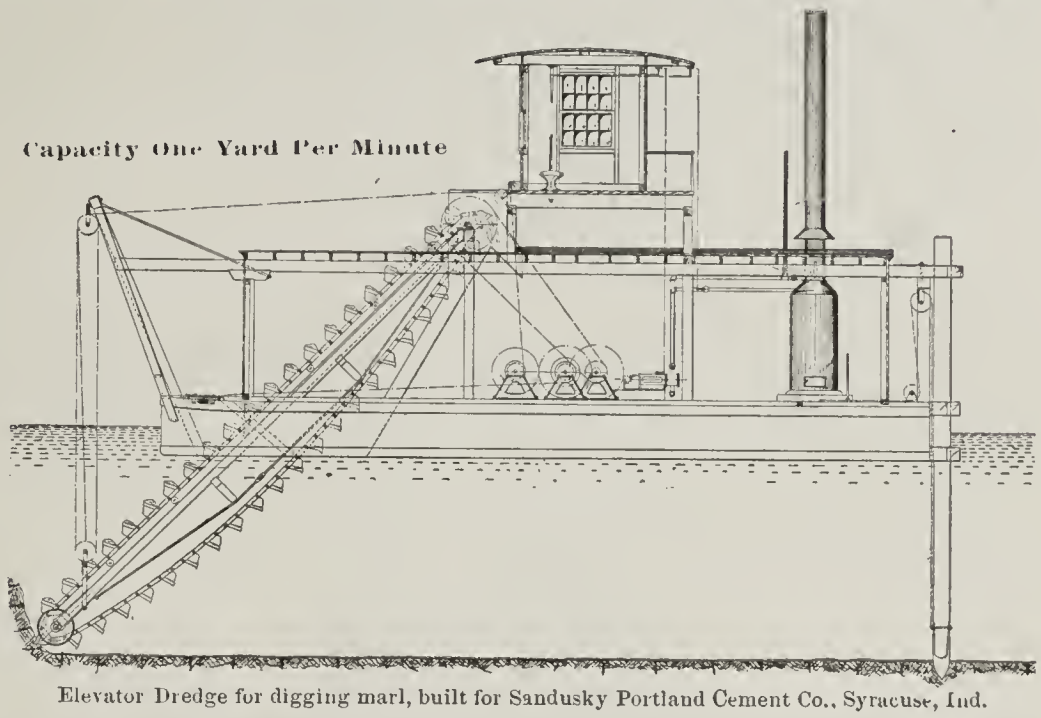

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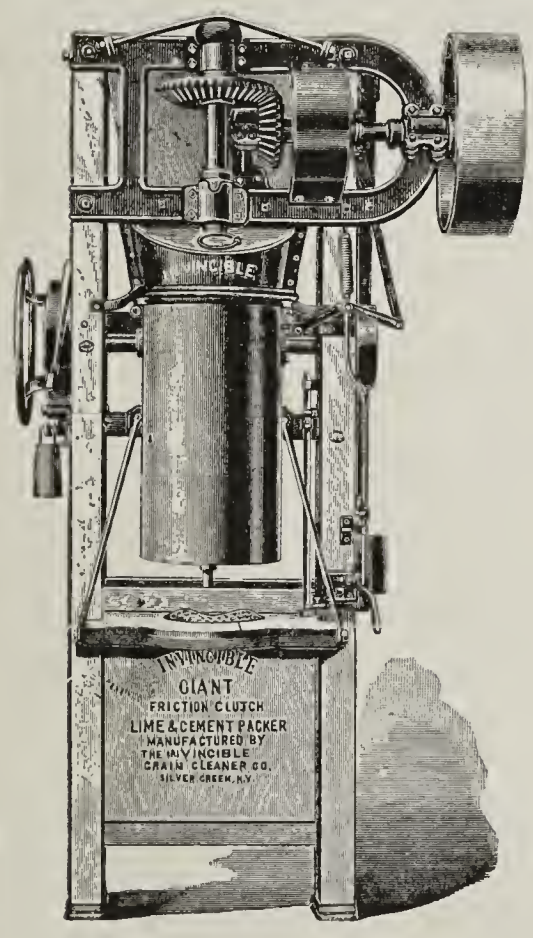

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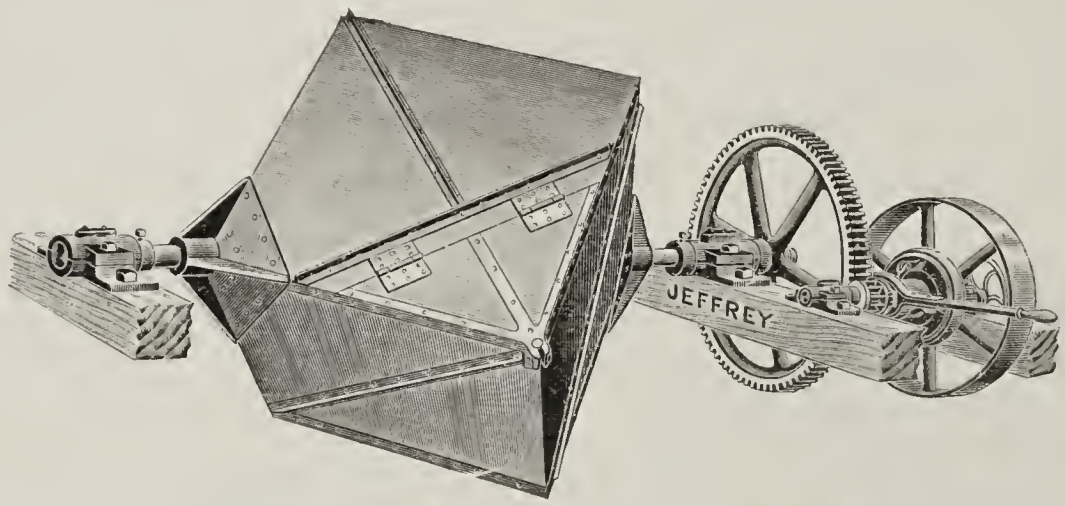

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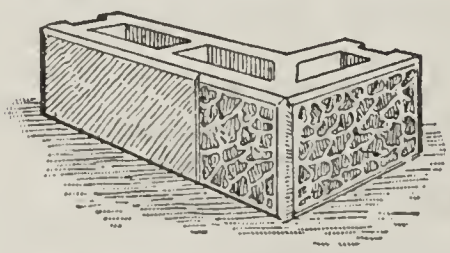

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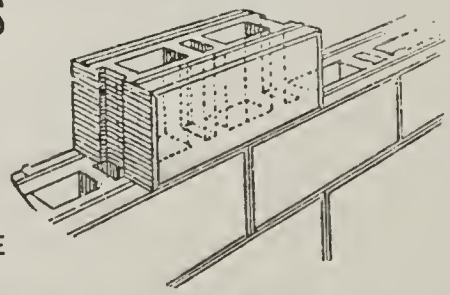

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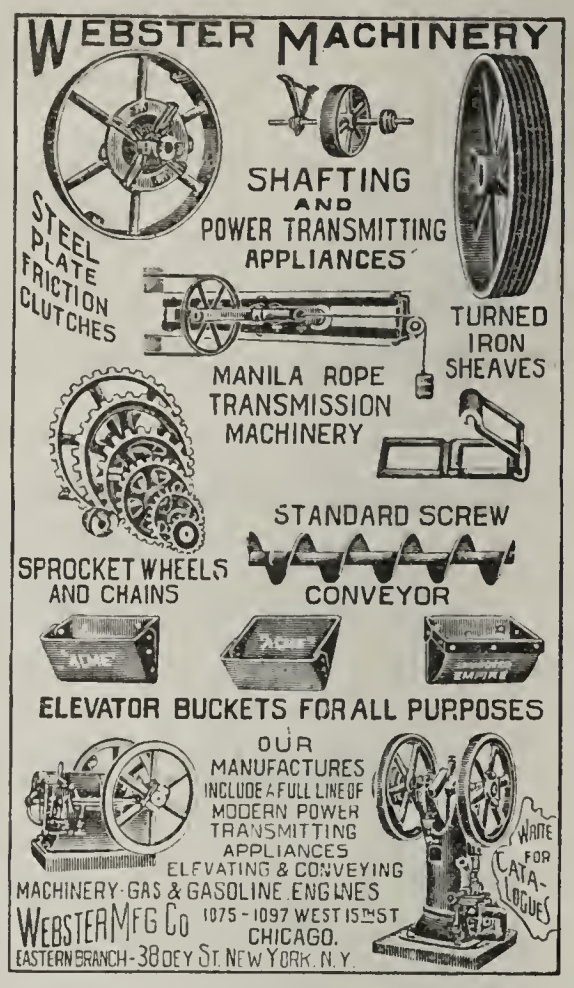

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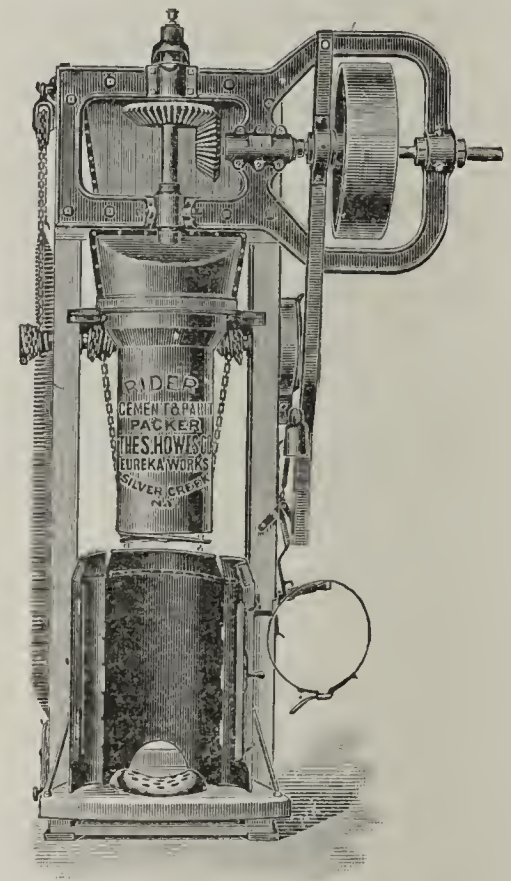

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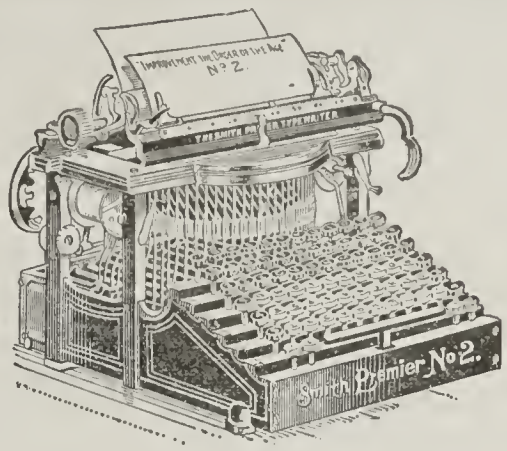

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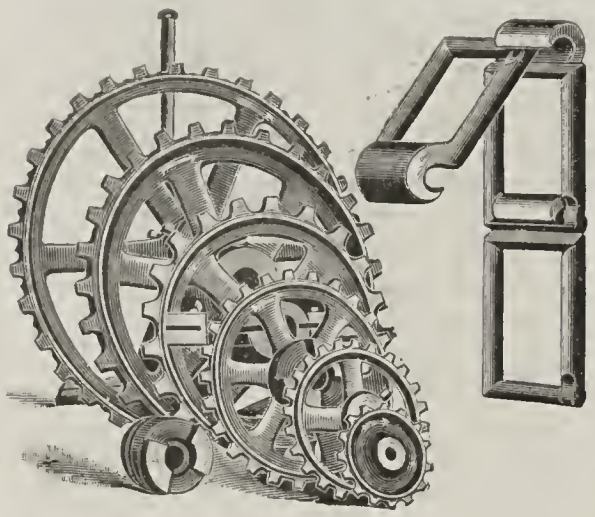

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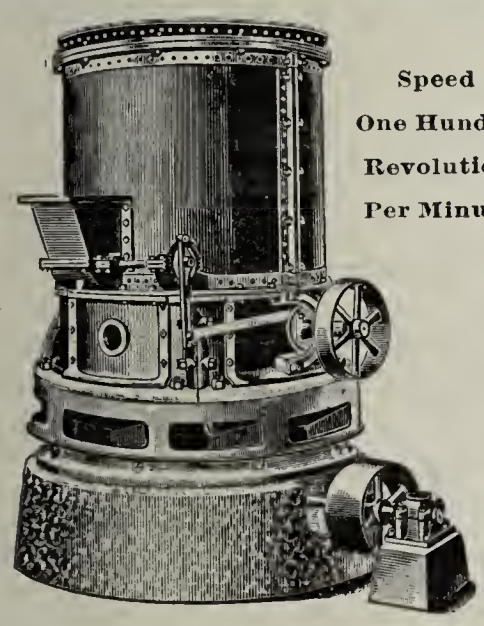

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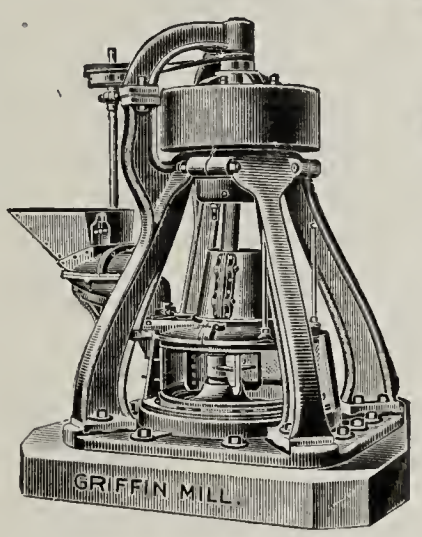

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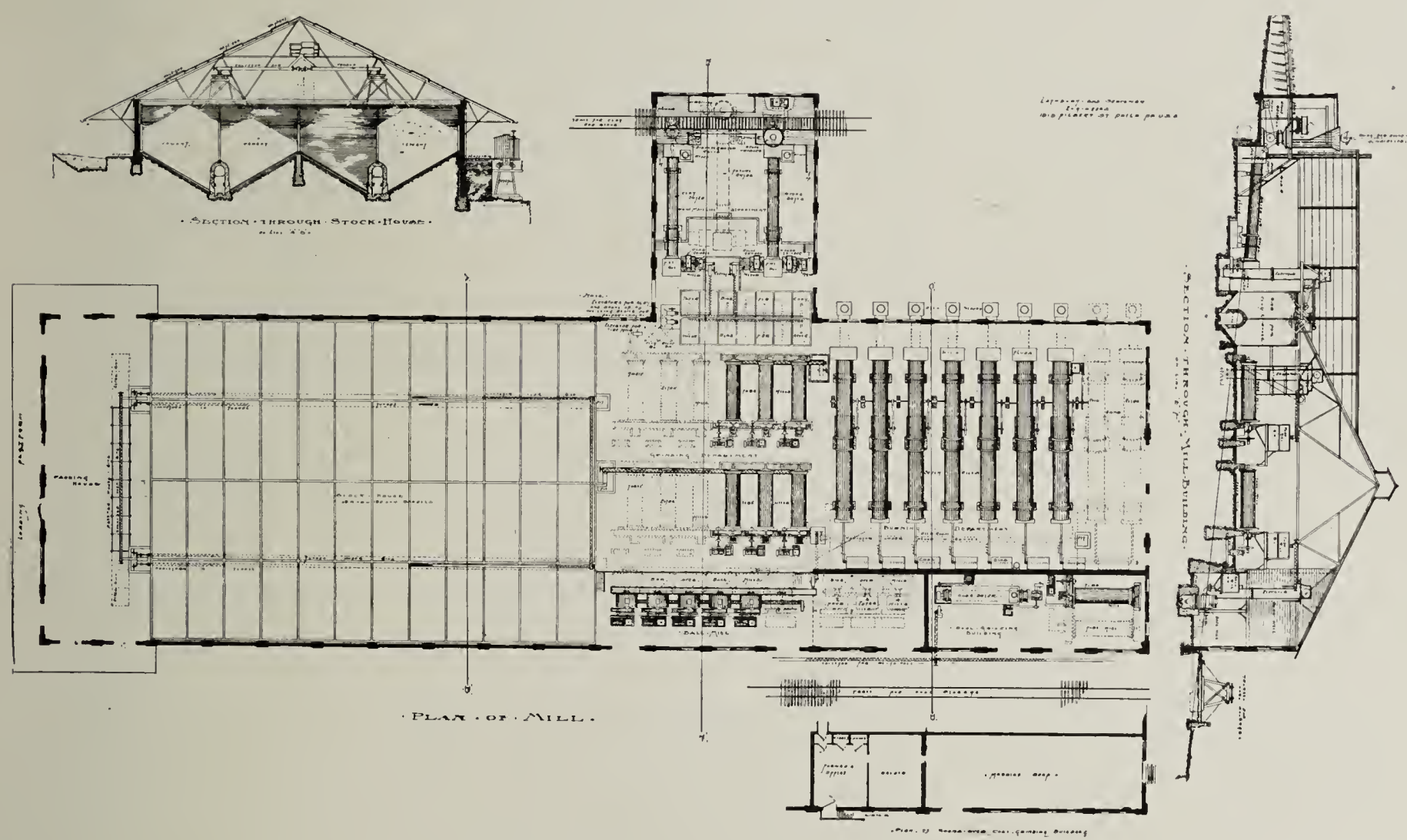

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

OVER-PRODUCTION IN EUROPE.

The Portland cement industry in Europe is not in a satisfactory condition, as it was in 1899. From every point comes the report of over-production and decline in prices, England alone excepted. Germany, Austria, Switzerland and Belgium are all carrying a surplus stock. The members of the German combine complain that mills outside of the combine are invading and cutting prices in their own local territory, which they cannot meet under the restrictions imposed by the syndicate of which they form a part. This results in considerable friction all round, with no solution in sight.

THE CEMENT MARKET.

Portland cement has declined 60 cents per barrel during the past five months, due to the sharp competition between the mills, in order to close out their surplus stocks. Portland cement has sold in Washington, D. C., for government work, as low as $1.55 per barrel in cloth, while lower sales have been made in Chicago by new mills entering the market for the first time.

The American mills are now in position to look for an export trade. With this end in view, the CEMENT AND ENGINEERING NEWS has applied directly and indirectly to the government for statistical information bearing on the Portland cement trade in South and Central America, to be gathered by the United States consuls therein located.

This information is now being collected and will soon be available to the American Portland cement manufacturer, whereby they may arrange to compete with European producers, who now have a monopoly of the business.

The American mills should make a good showing at the Pan-American Exposition at Buffalo, N. Y., next year. It will do much to open up trade relations with South America.

ISTHMIAN CANAL.

The United States Isthmian Canal Commission is to make its report in December. This will probably settle the route the government will adopt and subsidize. There are several serious objections to be urged against the Nicaragua route for a canal. First, its great length—194 miles; second, the shallow and unprotected harbor on the Atlantic side at Greytown. The shifting sands of the ocean have inundated all the works of man heretofore constructed. With a rainfall of 3 ins. in 1 hour, 9 ins. in 9 hours, and 25 ft. per annum on the Atlantic side, will seriously endanger earth-works. The severe storm at Galveston, Tex., should serve as a warning of the danger in relying upon an unprotected harbor, while there are other routes available—shorter and more direct—affording the most ample harbor facilities.

Dr. F. G. Wickes, attendant physician to the present United States Isthmian Canal Commission, reasserts that a tide-water canal can be built from Caledonia Bay on the Pacific to the Bay of San Miguel.

1. The line crosses a plain extending from S. W. extremity of the bight in Caledonia harbor to the entrance of a valley between Agla mountain on the S. E. and Sassarde mountain on the N. W. E. miles S. by W. $\frac{1}{4}$ W. (S. S. W. true).

2. Through the valley $3\frac{1}{2}$ miles S. E. by S. $\frac{1}{2}$ S. (S. S. E. true). On the way the line strikes upon the head of the Sucubti.

3. Down the Sucubti to the site of the abandoned hamlet $2\frac{1}{2}$ miles S. $\frac{3}{4}$ E. (S. true.) Canoes can come up to the hamlet, and even a couple miles above it, and can descend from thence to the Pacific via the Chuquanaqua and the Tuyra.

4. From the hamlet down the bed of the river to the confluence of the Asnati with it 7 miles W. S. W. (W. by S. $\frac{1}{4}$ S. true.) In this stage the Napsati falls into the Sucubti $2\frac{1}{2}$ miles above the Asnati.

5. From the Asnati mouth the line continues to follow the Sucubti down to its confluence with the Chuquanaqua on the east bank of which it opens $11\frac{1}{2}$ miles W. $\frac{3}{4}$ N. (W. by N. $\frac{1}{2}$ N. true.)

6. From the west bank of the Chuquanaqua, opposite the Sucubti mouth, and below the Artuganti and La Paz mouths to the confluence of the Lara with the Savana, it traverses the forest for the distance of $15\frac{1}{2}$ miles S. W. by W. $\frac{1}{4}$ W (W. S. W. true.)

The length of the line is 42 English miles, for which at least three may be deducted for the windings of the Sucubti, which would be cut across. It runs for 21 miles along the bed of that river, the lower 12 of which are pretty direct and would admit of being canalized by means of dams and embankments for a moderate outlay, leaving 27 miles for the length of canal required.

The entire transit from sea to sea will then consist of:

	Eng. Miles.
Canal	27
Canalized river	12
Navigation of the Savana	16
Navigation of the Tuyra	3
	58

The distance could be easily traversed in 24 hours, even making allowance for the time that would be occupied in the passage of the locks. The S. W. end of the bight being in Lat. 8 deg. 53 min. 45 sec. and Long. 77 deg. 43 min. 30 sec. and the mouth of the Lara being in Lat. 8 deg. 41 min. 45 sec. and Long. 78 deg. 7 sec., the distance between them in a direct line is 26 geographical or $30\frac{1}{8}$ English miles, and the course is S. 62 deg. W. (S. W. by W. $\frac{1}{2}$ W. true) or S. W. $\frac{3}{4}$ W. by compass allowing $\frac{3}{4}$ of a point for the variation, which was 8 deg. 50 min. E.

As the tide of the Pacific rises $6\frac{1}{2}$ feet at the bifurcation of the Lara ($3\frac{3}{4}$ miles above its mouth) and that point is less than 28 English miles from Caledonia harbor, the length of the canal required would be lessened by two miles by cutting into the river at its bifurcation and dredging it from thence to the Savana.

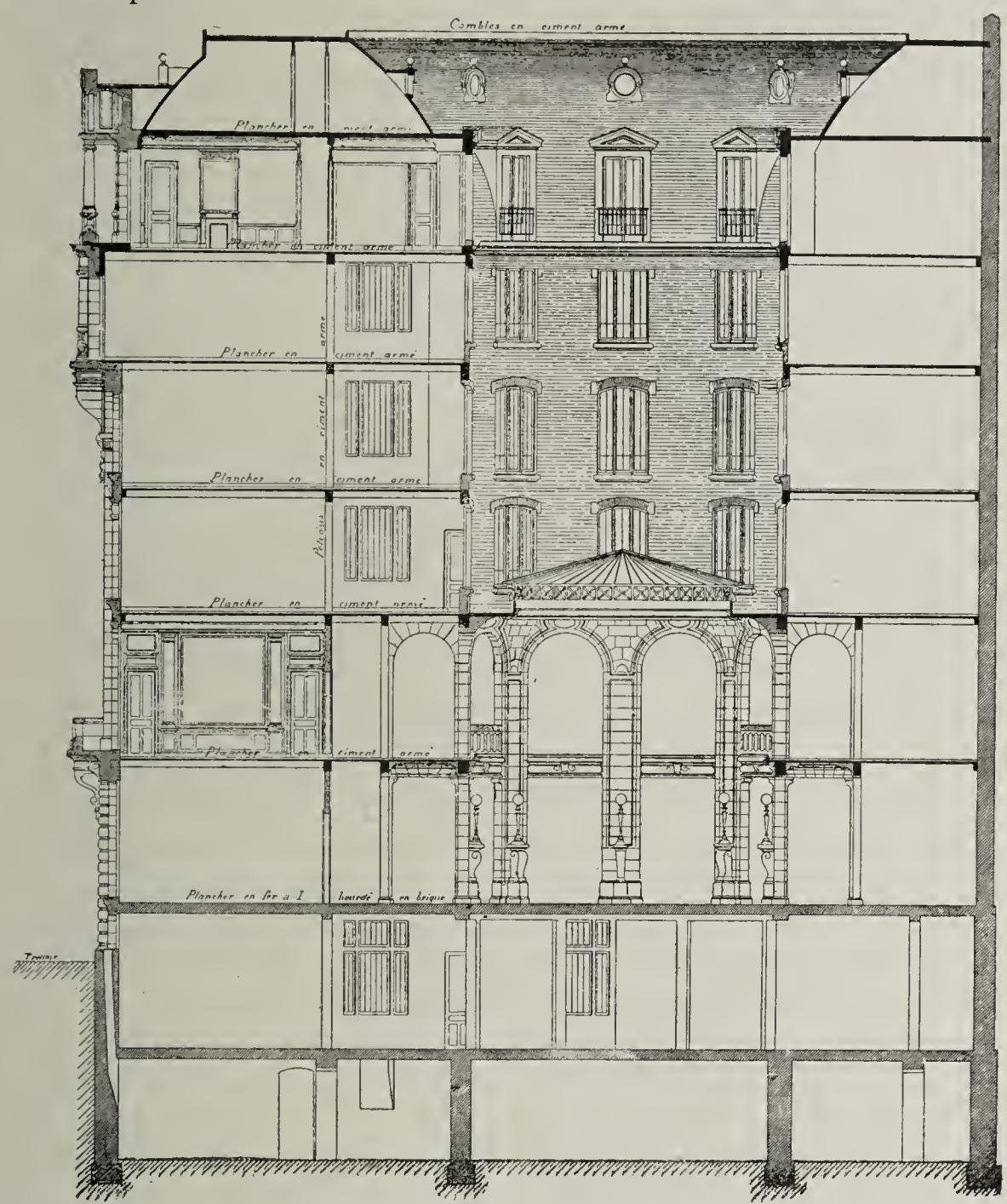
THOS. WRIGHT HURST.

The Schillinger Bros.' Company of Toledo, O., was incorporated on Nov. 24, with a capital stock of $27,000. The incorporators are:—Frederick Schillinger, William Hummel, E. W. Schillinger, Fred A. Schillinger and William P. Tyler. The company will do concrete paving and roof work.

LA BANQUE SPECIALE DES VALEURS INDUSTRIELLES IN PARIS.

Translated in part from *Le Ciment* by E. LEE HEIDENREICH.

The building consists, as the illustration shows, of a basement, a first story for bank purposes, second, third and fourth story for commercial purposes, fifth for apartments, and sixth for the domestics. The floor surface is about 900 square meters for each story, and the load for which these floors are calculated is about 450 kilograms per square meter or about 100 lbs. per square foot. The floors of the commercial department consist of reinforced concrete construction commonly known in this country as "Monier Constructions," 2 ins. thick and supported by ribs of 6 x 8 ins. located in 3 ft. 6 in. centers. In the apartments these ribs are concealed in a floor of 6 in. thickness. The length of the ribs is about 18 ft. and in some instances as much as 27 ft. 6 ins. The fifth and sixth story sides are formed by the cupola roof construction ending in a flat roof on top of the sixth story and built entirely in fortified concrete construction. The cupola or arched roof has a thickness of 6 ins. at the fifth floor. At the sixth floor the thickness of the roof supporting the floors is reduced to 4 ins., but the ribs are located in the partition walls strengthening the supports for the ribs concealed in the floors. The bay windows are supported directly from these floor ribs. The fortified cement constructions were commenced the 20th of August, 1899, and finished during the month of March, 1900. The test of the floors show that at a load of 150 lbs. per square foot there is a deflection of less than $\frac{3}{16}$ ins., although the floor load was designed at 100 lbs. per square foot. The length of the floor ribs tested were 17 ft. 7 ins.



The Monier constructions have, in France, developed a number of specialists who are using their particular methods of introducing the strengthening rods into the concrete or mortar, such as Coignet, Hennibique, Bonna, Cattancin, Degon, etc., etc. The building above referred to was executed under the system Coignet.

Brazil imported, in 1899, Portland cement from Belgium 98,489 barrels, from France 16,045 bbls., from England 8,822 bbls., from Germany 6,654 bbls., from other countries 946 bbls., making the import for that year 130,956 bbls., against 135,960 for 1898.

BURNING DAMAGED CEMENT.

Executive Engineer R. W. Egerton of the Northwestern Railway describes the results of re-burning cement damaged by floods during the progress of the Khojak tunnel. To this end a furnace was employed which had been used for heating through sleepers before re-shaping them, the fuel used being dust coal. The damaged cement, which in most cases was found to be set solid to the center, was taken out of the barrels, broken into pieces which would pass through a 3-inch ring, placed in the furnace and the firing kept up day and night. After burning and cooling, the cement was ground in a steam mortar mill and screened in a revoluing screen of 1600 mesh. The material so treated was found to heat when slaked, if used fresh, but this tendency disappeared after air slaking 15 or 20 days. The results of tests showed the material to have an average strength of nearly 200 lbs. after a period of slightly more than two months, or about one-third of the original strength. The re-burning was done at a sufficiently low cost to make the expenditure profitable, and the re-burned cement mixed with three parts of sand to one of cement, gave excellent results.

POWER TANSMISSION MACHINERY.

The Weller Manufacturing Co., 118–126 North Ave., Chicago, have just issued an elaborate catalog and price list of articles manufactured by them. It embraces elevating and conveying machinery, mill and mining supplies, extra large rubber-covered cast-head pulleys, improved friction clutches, machine-mold cast pulleys, manilla rope transmission appliances, plain spur-gears, mitre gears, sprocket wheels, wire rope car pulling drums, etc., special barrel and sack elevators. Numerous tables and other interesting information is to be found within its covers.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

Germany has 70 Portland cement mills producing 18,000,000 barrels.

BEHAVIOR OF HYDRAULIC CEMENTS IN SEA WATER.

Some months ago a comprehensive report was published in the "Communications of the Royal Technical Testing Institute in Berlin" on tests made to determine the behavior of hydraulic cements in sea water.

We intend to abstract the most interesting features from this paper, but, before doing so, we must make the reader acquainted with the cause of those experiments.

The inducement was given at the request of Dr. W. Michaelis, Sr., of Berlin, and that of the owners of trass quarries on the Rhine directed to the Royal Prussian Ministry of Public Labour in 1896.

Dr. Michaelis asserted in his paper, "Action of Sea Water upon Hydraulic Cements," that Portland cement used for sea buildings can be improved by an admixture of puzzuolanas, especially by trass.

He was led to make this assertion by laboratory experiments, which suggested to him that Portland cement is a compound supersaturated with lime. A great percentage of this superfluous lime, according to his theory, is separated from its original compounds in the hardening process of the mortar and is thus able, in the state of hydrate of lime, to act upon the magnesia salts dissolved in sea water, according to the equation:

$$Ca(OH)_2 + MgSO_4 = Mg(OH)_2 + CaSO_4$$

The so formed sulphate of lime partly crystallizes and cracks the cement, partly acts upon the ferrates and aluminates of lime, forming double compounds with them. These double salts also crystallize with a considerable quantity of water and increase greatly the expansion of the hardened mortar.

In order to prevent the injurious influence of sea water on the hydrate of lime liberated while the hardening goes on, Dr. Michaelis proposes to give the hydrate of lime occasion to form insoluble compounds before the sea water can act upon it. To enable this he adds puzzuolanas to the cement, that is to say natural volcanic products rich in soluble silica, or with other words, substances which form cement with hydrate of lime. The lime then combines with silica at the moment when separated from its original compounds and forms insoluble silicate of lime, which can no longer be acted upon by sea water. Of the three volcanic products containing soluble silica, Puzzuolana, Santorin Earth and Trass, the last proves to give the most satisfaction.

Dr. Michaelis deduced his theory from experiments made on several of the best Portland cements, in fresh water as well as in sea water without an addition of trass and with trass. While the tensile strength and compressive stress of the test pieces without trass kept in sea water remained behind the figures of the corresponding test pieces immersed in fresh water, the test pieces with an addition of trass showed the highest increase when kept in sea water.

This theory, that Portland cement can be improved by an addition of trass, met with the greatest opposition on the part of the Association of German Portland Cement Manufacturers, who declared that "normal cements do not need a so-called improving admixture." Experiments carried on for several years by the association with cement-mortars and lime-trass mortars immersed in sea water on the island of Sylt, North sea, seemed to prove the superiority of Portland cement over other cements, also over lime-trass mortars. These experiments, however, did not include reliable experiments with admixtures of trass to cement. Of these mixtures, cement with an addition of trass kept in sea water, tests of a month only had been made at that time by the association, which showed no improving qualities from the addition of trass. New experiments over a longer period had, therefore, to be made with the last named admixture before any definite statements could be made.

Moreover, the owners of trass quarries on the Rhine objected to the method adopted by the association for the preparing of lime-trass mortars.

The opinions of both parties were submitted to the Royal Technical Testing Institute in Berlin, which after mutual arrangements was entrusted with the making of experiments in sea water on a large scale.

In accepting the position of arbiter, the Royal Institute deliberated, "that, in case the improvement of Portland cement by an addition of puzzuolanas, as stated by Dr. Michaelis, be true, this would be of considerable advantage to industry and construction, and that, on the other hand, in the interest of the constructors, care must be taken that the quality and quantity of admixture is confined to certain limits and that adulteration is prevented."

In working out a plan for the experiments to be made, it very soon appeared that only experiments over many years could be expected to give reliable results, that the most different cements ought to be employed and that the single making of test briquettes and cubes, as customary for the testing of tensile and compressive strength, was no longer sufficient, but that at the same time large concrete blocks ought to be exposed to the waves. The immediate adoption of this plan would have caused extraordinarily great expenses; therefore it was considered necessary to make, at first, experiments over a period of a year on a smaller scale, in order to ascertain whether or not Dr. Michaelis' theory proved to yield practical results. If these first experiments proved to be satisfactory, the working plan should be increased and extended over many years.

These preliminary tests, the result of which proved in fact the property of trass to render Portland cement better adapted for sea buildings form the object of the mentioned communications of the Berlin Testing Institute.

According to Michaelis' theory the cements that are the richest in lime are the least resisting in sea water. Therefore cements with varying contents of lime had to be taken for the experiments.

Thus the following Portland cements were selected:

A—Rich in lime; poor in alumina.
B—Rich in lime; rich in alumina.
C—Poor in lime; rich in alumina.

As admixtures for the making of test pieces, except standard sand used in different proportions, trass and ground quartzsand of equal fineness were taken, the latter with the view to ascertain whether trass acts chemically or only physically in the mortar.

The report then gives a detailed description of the physical and chemical properties of the substances employed, discusses the method of making test pieces and mentions the apparatus used in the testing. The tensile and compressive strength are tested after 7 days, 28 days, 3 months, and one year. The obtained figures are clearly arranged in tables, in which the strength of the test pieces kept in fresh water is opposed to those kept in sea water. At the end the conclusions drawn from the experiments are given as follows:

The three cements employed were normal Portland cements, only differing slightly in strength. Cement A with the highest content of lime possessed the highest compressive stress.

The hardening process was regular with all test pieces as well in fresh water as in sea water. The strength advanced uniformly until at three months; from that time it increased only slightly or not at all. In some sets the strength of the pieces kept in sea water decreased after a certain time, especially the tensile strength of some mortars without an addition of trass.

In sea water the strength of the sand mortars slowly increased, even after 3 months, but remained far behind the strength of the pieces kept

in fresh water, which, even up to one year considerably increased.

In fresh water the substitution of trass and quartz sand for cement generally decreased the strength of the mortars, as was to be expected, and that about equally with all three cements, only in some sets a limited addition of trass increased the strength of fresh water pieces. Test pieces of quartz sand instead of trass showed less strength.

In sea water the tensile and compressive strength of test pieces, 7 days old, with admixtures was considerably less than those of the mortars without admixtures. But in a month the tensile strength of the trass mortars surpassed that of the pure cement mortars, while the compressive stress of the trass mortars still remained behind that of the pure cement mortars. At the end of one year, however, the compressive stress of the trass mortars was very near to that of the pure cement. Only the compressive stress of the trass mortars of cement C (poor in lime, rich in alumina) was, after one year, higher than that of the pure cement mortars.

Both in fresh water and in sea water a limited admixture of trass seems generally to be more favorable than a great addition. The influence on the tensile strength is different from that on the compressive stress. Fresh water effects the increase of compressive stress of the mortars with limited admixtures of trass more favorably than sea water, while sea water favors the tensile strength of these mortars in a high degree. An exception form the tensile strength briquettes of cement A, that with the highest content of lime, the tensile strength of which is more increased by a greater addition of trass than by a lower. Also as to compressive stress, this seems to be true, but the influence of the greater addition of trass seems here to come into force later.

The quartzsand mortars have generally the same hardening process as the trass mortars, but as to their tensile strength they stand so far behind these, that the difference between both is most evident. Therefore it cannot be assumed that the effect of both materials is exclusively physical.

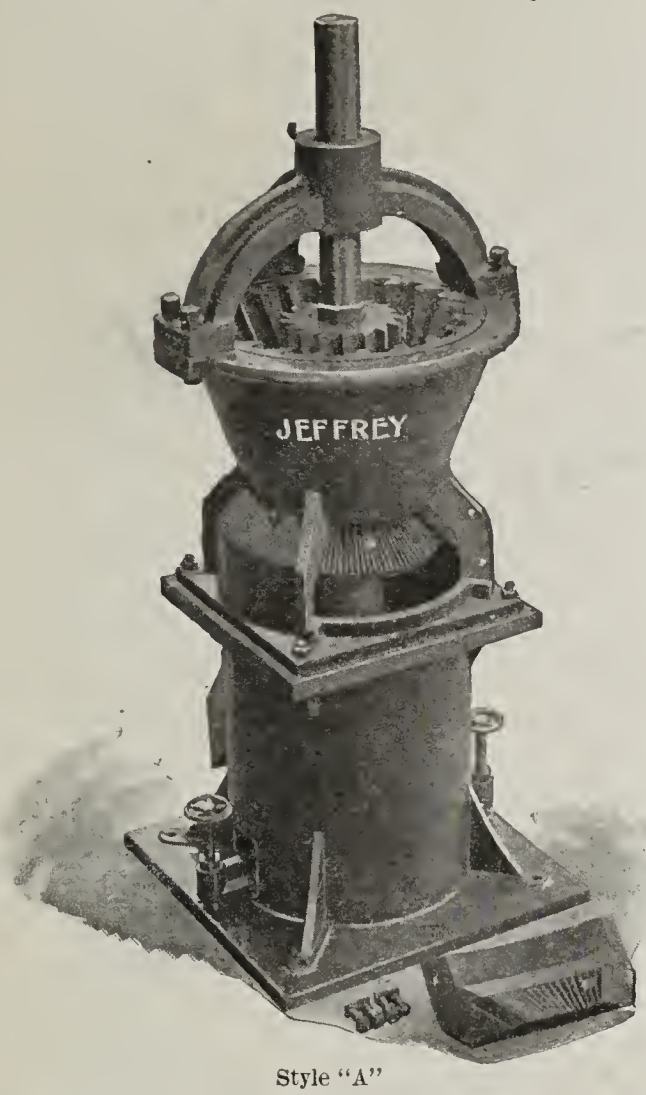
The favorable action of trass admixtures in sea water has more influence on cement C (poor in lime) than on cement A (rich in lime).

The result is summed up in the following words: "According to the preceding statements it is proved by these preliminary tests that it is possible to render Portland cements by admixtures of trass within certain limits more suitable for use in sea water."

"How far these limits are to be extended with cements of different origin must be found out by special experiments on a large scale and with long times of observation, because experiments with small test pieces do not always admit a sure conclusion as to the behavior of large blocks."

ROTARY CRUSHER.

This type of rotary crusher meets the demand as an intermediary machine for reducing material the size of ordinary building brick to a size small enough for buhr mills and the general line of pulverizers. It is used successfully for crushing phosphate rock, cement rock and similar material. It is substantially built in every particular; its base and bowl are of gray iron, its shaft of hammered steel, while the liners and crushing nuts are of a special very hard metal. The crushing nuts and liners are made in different sizes to accommodate the wear and tear. The upper nut on the shaft is always the same diameter. The two lower nuts in style "A" crusher are made in three sizes, 13, 13½ and 14 ins. in diameter. In operation the smallest nut is used first and as this becomes worn the larger sizes are substituted. The pans or side liners usually last until the largest nut has been used and worn out, after which a complete new set of liners and nuts must be substituted. For fine crushing style "B" machine is used, which has a secondary set of nuts and liners. The upright shaft has its lower bearing in an adjustable step box, which permits varying the size of the product.



Style "A"

The driving power is preferably applied at the top.

The capacity of the machine is from 6 to 10 tons per hour, carrying according to the material and the size to which it is crushed. It requires from 10 to 15 horse power and an 8-in. belt to do the work. These crushers are built by the Jeffrey Manufacturing Co., Columbus, Ohio.

GERMAN CEMENT SYNDICATE.

The Northwest and Middle German Portland Cement Syndicate on November 3 fixed the sale price of Portland cement for 1901, as follows: 7.20 marks (about $1.73) per No. 1 normal barrel of 170 kil. (about 376 lbs. net) delivered f.o.b., with a rebate up to $9\frac{6}{10}$ cents to established dealers. Consumers using 50 double cars or more per year will receive a like rebate. Large dealers will receive a rebate of 2¼ cents per bbl. off list to his customers. The lowest net price to the purchaser of 50 double cars is fixed at 6.80 marks where it was 6.75 marks last year. The syndicate will become effective Jan. 1, 1901, in Hanover, Hamm and Dortmund.

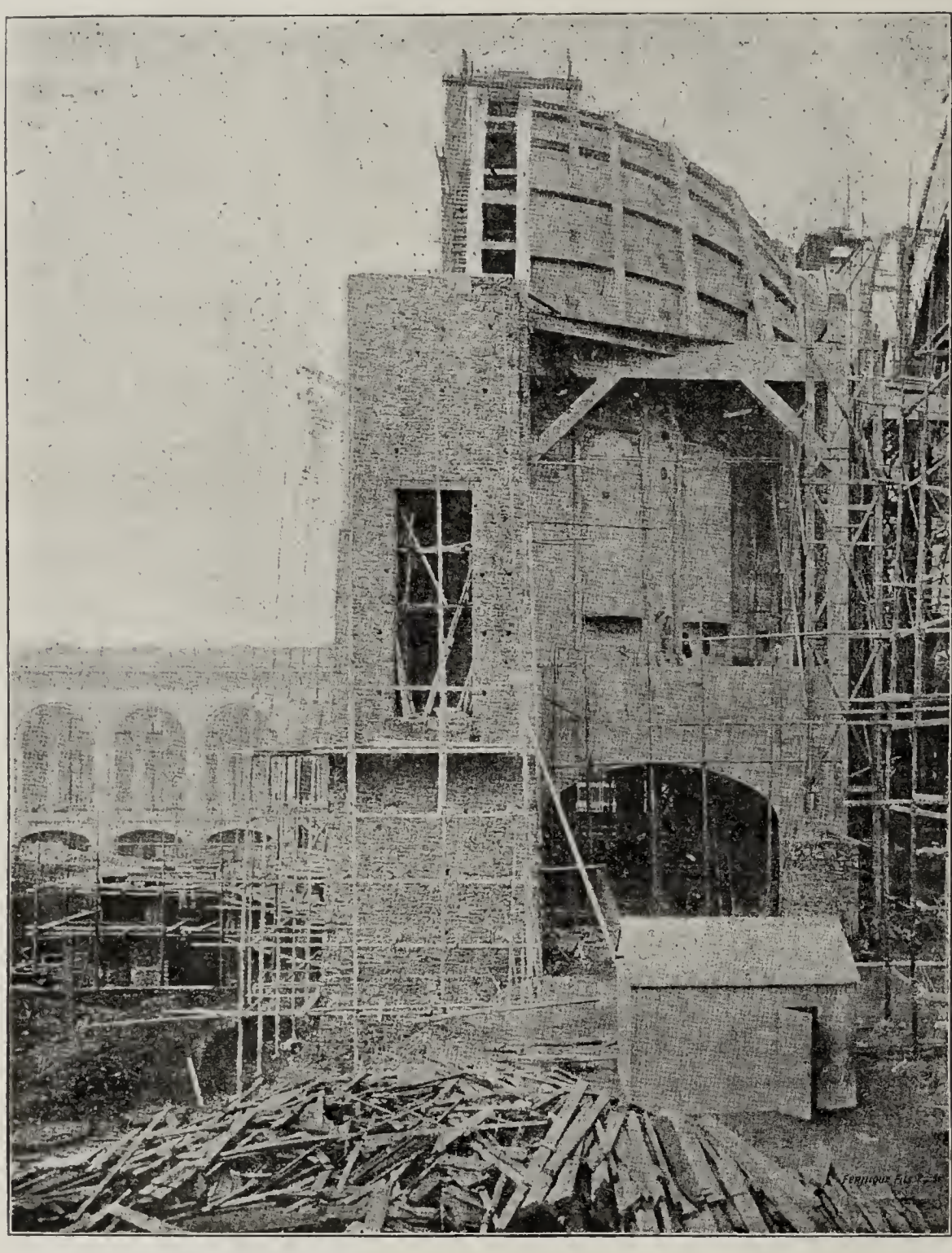
Send in your subscription for the CEMENT AND ENGINEERING NEWS.

Style "B"

CHATEAU D'EAU, PARIS EXPOSITION.

From *Le Ciment.*

We give two illustrations of the Chateau D'Eau as the building containing the grand cascade, water terrace and electric fountain is designated, located on the camp De Mars, Paris Exposition. The main structure is in the form of a highly ornamented niche, 144 ft. high and 81 ft. wide and is constructed entirely of cement and steel rods. A grand cascade descends from near the dome of the niche, filling its interior. The water continues to descend over a series of terraces and around a magnificent electric fountain. The Chateau foindoine is one of the most attractive and novel features of the exposition. One of our illustrations shows an exterior view of the building under construction with the rough face of the concrete exposed. The illustration on page 73 shows a cross-section of the niche, terrace and fountain.



Chateau D'Eau—Cascade and Electric Fountain under Construction of Concrete and Steel Rods.

TROUBLE IN THE GERMAN CEMENT INDUSTRY.

IS A CRISIS COMING?

In looking at the German cement industry there is to be observed a falling off in the building of new private houses in nearly every German town, yet this has not been felt in the consumption of cement. The reason for this is that great quantities of cement are required for the building of fortresses and other government buildings, and the daily increased requirements for which cement is used. But the demand does not keep abreast with the production, which has been enormously increased by the enlarging of old plants and the erection of new ones. The big profits of the factories for 1899 presented evidently too great an attraction for capitalists to resist. Furthermore, since May last there has been a general decrease in the export to the United States and a steady growing of the American cement industry. An illustration of this may be found in the report of Mr. Wyndham, the British consul at Chicago, which shows that the falling off of the American consumption is not only felt in Germany but in England as well. Reviewing the commerce of Chicago Mr. Wyndham observes that "cement is not mentioned at all as imported from the United Kingdom and little from Germany and Belgium. This may be accounted for by the fact that large cement factories have been established in the state of New Jersey and at Chicago." The formation of the "cement trust" in England has been the reason for new endeavors for a similar organization in Germany. There are already several minor combines in the confederacy; but it is now felt that the time is ripe for a general organization. If a satisfactory understanding can be arrived at by the different combines is a matter of speculation, as there are signs that even those loosely formed organizations will dissolve, because several of the manufacturers are dissatisfied with the pro rata production accorded to them, though it must be said that in Silesia and in South Germany the combines still hold good for several years, and have been joined by the new works erected in their district. Where the danger comes in is in the Northwestern and the Central parts of Germany. Here so many new works have been erected at a high cost that the supply is much larger than the demand. When the new works are included in the combination the older works are compelled to produce less cement in order to keep the market price up.

This will not go down with many of the owners, and a lot of difficulties have cropped up so that it is very likely that the syndicate, for the formation of which negotiations are still pending, will not come off. Should this be the case a crisis in the German cement industry may be predicted, as the new works would try to secure themselves a market at any price. This, in its turn, would effect the cement works near Berlin and at Stettin, and the factories belonging to the other combines, and it is a certainty, that the American markets soon would be flooded with German cement, which the works would be compelled to sell at nearly any price offered them. P. T. O.

London, Eng.

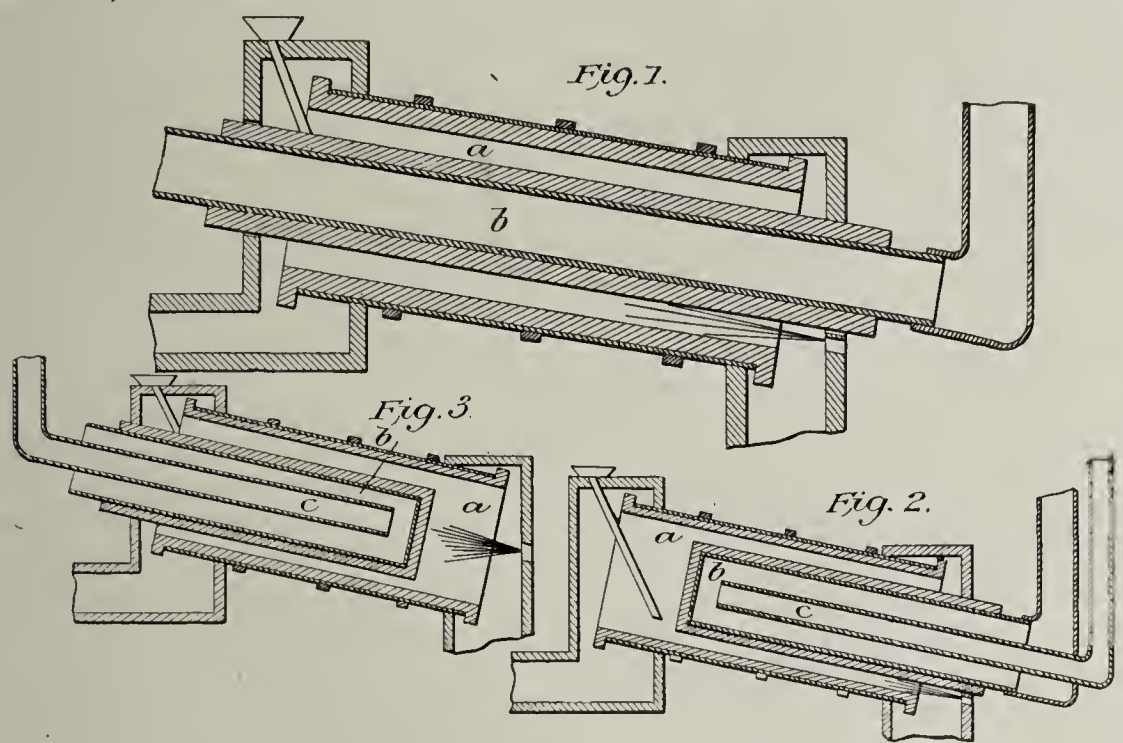
The Portland cement industry in Japan is in a very prosperous condition. The largest plants are located at Tokio and Shimonoseki. The demand is much beyond the capacity of native works to supply, therefore, large quantities are imported. The native cement has been much improved during the past few years.

P. O. KROTTNAURER PATENT ROTARY KILN FOR PORTLAND CEMENT.

Figures 1, 2 and 3 show vertical longitudinal sections of three constructions of the improved kiln or oven.

The oven comprises an iron or other metal rotary inclosing chamber *a*, which is arranged at an inclination and is lined with some refractory material, as chamotte or the like. The material or goods (cement, lime, or the like) to be burned are introduced into the said chamber from above at the higher end through a funnel-like feeding device or hopper *d*, while the flame enters, preferably, at the bottom of the opposite end *e* of the kiln from the burner *f*, outside the pipe *a*, and flows in the opposite direction to that in which the goods move. The heating gases are, after they have left the kiln, conveyed into a chimney or are otherwise utilized. The burned goods fall out of the lower end of the rotating oven into a storage receptacle, from which they are taken for further treatment. A second body *b* is arranged inside the chamber *a*. The said body *b* is made of steel or of another metal or substance which easily absorbs heat and is jacketed or covered with a fireproof or highly heat-refractive material. As the internal body *b* is strongly heated by the gases of combustion, its resistance and durability are increased by introducing into it a cooling medium. The cooling medium (water, air or the like) which is conveyed to the body *b* is in the arrangement illustrated in Fig. 1 introduced into the higher-lying end of the body, flows through the said body in the opposite direction to that in which the flame passes, and is, after it has passed through the body, further utilized for heating the drying or manufacturing rooms. The cooling medium for the pipe *b* can, however, be also conveyed into the inside of the kiln. When, for example, air is employed in said pipe as its cooling medium, a portion of this air can be conveyed through suitoble openings in said pipe into the inside of the burning-chamber *a* as strongly-heated secondary air to supply oxygen for increasing the heating effect in this chamber.

The iron pipe *b* can, as illustrated in Fig. 1, pass completely through the kiln or, as illustrated in Figs. 2 and 3, only partly there through and it can be fixed or arranged to rotate.

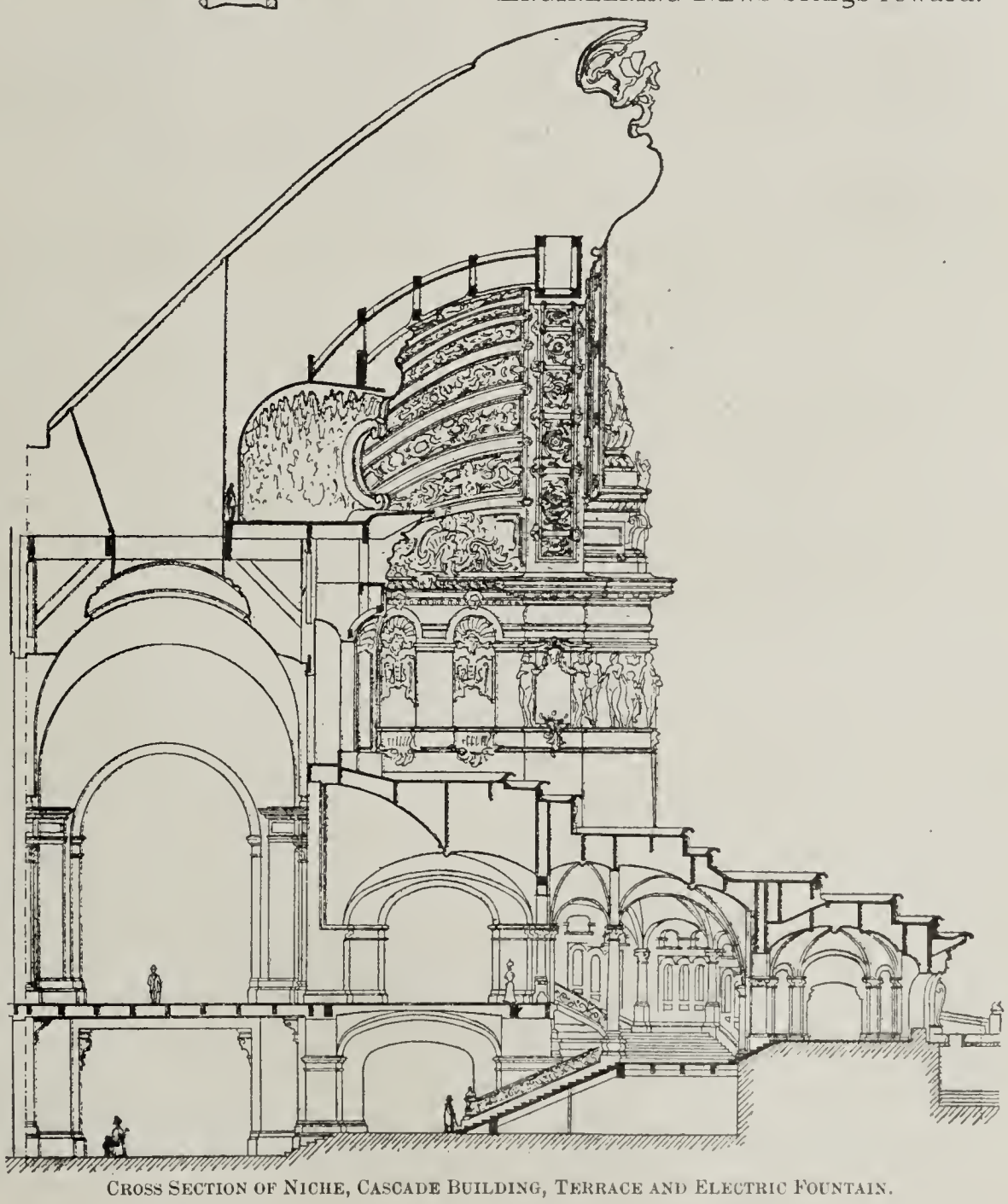


In the construction illustrated in Fig. 2 the pipe *b*, which is covered with fireproof material, is passed into the kiln from the lower end, while in the arrangement illustrated in Fig. 3 it is introduced from the upper end thereof. In order to apply the water or air cooling in these two latter constructions, it is necessary to provide the metal body *b* with a smaller body *c*, through which the cooling medium can be introduced. The body *b* can be arranged either concentrically or eccentrically to the outer jacket or body *a*.

From the above it will be seen that the pipe *a* has throughout its entire length a refractory core or body materially filling up the space within said tube and presenting to the action of the flame and heat a great heat-absorbing surface and which will be near the material to be treated and able to readily refract the heat to said material wherever it may be in the tube *a*. By making the interior core or body tubular or hollow and passing the cooling medium through it its durability is greatly enhanced.

The Alta Cement Co. will erect works at Rushsylvania, Ohio.

An advertisement in CEMENT AND ENGINEERING NEWS brings reward.



CROSS SECTION OF NICHE, CASCADE BUILDING, TERRACE AND ELECTRIC FOUNTAIN.

ENGLISH SLAG CEMENT PLANT.

The Western Counties Cement and Slag Making Company of Barrow-in-Furness, Eng., has recently erected a large slag cement plant, of which we give the following data:

The engine-house contains engines of 300 horse power, compound condensing, with a belt flywheel 11 feet in diameter and 2 feet 6 inches broad, weighing 11 tons. The engine-house stands in the middle of its own water reservoir, the basement of the engine-house wall on two sides forming the sides of the water tanks. These tanks are connected with extensive cooling culverts 6 feet high and 3 feet broad, running through the base of the engine-house to the extreme limits of the land on each side. The hot water from the engine tanks is so arranged that it flows automatically, and is fed directly to the boiler without pumping. The boiler works at 100 lbs. pressure and is fitted with a Meldrum's patent furnace.

The grinding machines are of American make. These are fed from a massive wooden hopper in the room above, which holds two large railway trucks of prepared cement at one time. These two machines are each supposed to turn out five tons of finished cement per hour. The cement is fed, ground, elevated, and sacked without being touched by hand, seven sacks being filled at one time. The machines take 50 horse power each to drive and are driven with half-twist belts, double-ply, 12 inches wide, 25 feet centres, an awkward drive to arrange, and requiring considerable skill to adjust.

The slag dryer is a revolving cylinder 40 feet long, which slowly revolves and keeps turning over and propelling the slag and drying it by a very hot furnace underneath, the heat from which is drawn through the slag and cylinder by a hot-air fan driven at great speed. This dryer will turn out five tons of slag per hour.

The flag-making department contains a most ingenious machine, which is the joint invention of the maker and Mr. Ody, the manager. This flag-making machine turns out a flag 3 feet by 2 feet 6 inches by 2 feet, in three minutes, and ready edged—a most difficult flag to make on these machines. This is the only machine of this type in existence. The machine is so arranged that four molds are in process of being filled, pressed and stamped at the same time. The pressure exerted by the hydraulic ram is 2,500 tons, or $2\frac{1}{2}$ tons per square inch.

A full gauge railway, 400 yards long, has been laid down, so that the railway trucke may come up into the works for loading and unloading, feeding the flag mixers, coal bunkers, store rooms, slag dryers, etc. A light railway, 300 yards long, for light haulage by light bogies to various parts of the works has been provided.

THE GYPSUM INDUSTRY.

Edward W. Parker of the geological survey has completed the report of the survey on gypsum for the year 1899, and it will go to the printer in a short time, from which we select the following:

The better grades of the gypsum are ground and calcined and used in the production of plaster of Paris. The poorer grades, not suitable for this purpose, are used as a fertilizer. For this latter use the gypsum serves the peculiar purpose of helping moisten the soil. It is spread on the ground during the dry weather, and has the peculiar quality of gathering the dew and dampness in the atmosphere and later gradually giving it off to vegetation. Extensive gypsum deposits are found in Iowa, Arkansas, Kansas, Texas, Oklahoma, and the Indian Territory. Operations are carried on in Webster county, Iowa; Barber, Saline, Marion, Marshall and Dickinson counties, Kan.; at Quanah, Tex., and Okarche, Okla.

Over 43 per cent of the total product of gypsum in 1896 was obtained from Iowa, Kansas, Indian Territory, South Dakota and Texas, and more than 95 per cent of this product was calcined. Deposits near the town of Quanah, in the Northwestern part of Texas, are exceedingly interesting. They are located on both sides of South Grosbeck creek, five miles west of Quanah. The Fort Worth and Denver railroad crosses the deposit. The gypsum rock lies about 12 feet below the surface, overlaid with material in a disintegrated condition, known as "gypsite" or "dirt." Part of this dirt is gray in color, but most of it is snow white. It is all marketed. The "dirt" is mined by scraper drawn by mules, the gray and white materials being mixed before charging into the calcining kettles or tanks. Care is taken to secure about the same mixture for each charge. The calcined product of the "dirt" is of an attractive shade of gray colors, and is used entirely for wall plaster. It is of excellent quality, so far as color and durability are concerned, and sells at a higher price than the plaster made from the gypsum rock, which is of brilliant white, and is used for the white coating over plastered walls, and the usual purposes of plaster of Paris in the arts. A finer grade of the white plaster is used by dentists for making plaster casts.

On this deposit is a large mill well equipped with the most modern appliances for economical work, and hand labor is reduced to a minimum. The crude "dirt" and rock are obtained a few feet from the door of the mill. The property upon which the deposit is exposed covers several acres, though the beds probably extend under ground for a number of miles in all directions, as artesian water from wells within a radius of five miles is highly impregnated with gypsum, similar to that of the creek crossing the deposit. The water is commonly known as "gyp" water in the neighborhood. It is not fit for drinking purposes for mankind, but horses, cattle and other animals seem to thrive on it.

The year 1899 was one of record-breaking activity in the production of gypsum and calcine plasters. The amount of the product was 47 per cent larger than 1898, which was the year of previous maximum production. The value exceeded that of 1898 by 37 per cent and that of 1895, the year of previous maximum value, by 30 per cent. The total product of 1899 was 428,661 short tons, against 291,-638 short tons in 1898 and 288,982 short tons in 1897. The value of the output taken for the material in its first marketable shape in 1899 was $1,036,860, against $755,290 in 1898 and $755,864 in 1897. The increase in value, substantial as it is shown to be, was less in proportion than the increase in product. This was due to the unusually large amount of crude gypsum sold (larger in amount than in any year since 1889) and to a slight decline in the price of crude rock and land plaster. There was a slight advance in the price of calcine plaster, in addition to the notable increase of the product. The amount of calcine plaster (including wall plasters and the finer grades of plaster of Paris) manufactured in 1899 was 248,723 short tons, against 190,083 short tons in 1898, an increase of 58,640 tons, or 31 per cent. The value of the calcined plaster increased $213,831, or 33 per cent, from $657,-303 in 1898 to $870,146 in 1899. The production of land plaster increased 21 per cent from 40,929 short tons in 1898 to 49,430 short tons in 1899.

The production of the year is given by states as follows: Colorado and Wyoming, total product, 5,675 short tons valued at $24,954; Iowa and Kansas, 110,046 short tons valued at $293,690; other states, 101,585 short tons valued at $282,153.

Under the classification of "other states" the following are included:—Arizona, 47 tons; Indian Territory, 12,000; Montana, 582; Ohio, 20,887; Oklahoma, 10,852; Texas, 53,773, and Utah, 2,352.

LONDON UNDERGROUND RAILWAY.

The new electric underground railway in London has occupied four years to construct and cost £3,500,000 ($17,032,850), the cost per mile having amounted to £580,000 ($2,802,670). The line runs from the Bank of England, in the center of the city proper, to Shepherds Bush, a distance of 6 miles, and between those points there are eleven stations—making thirteen in all. The fare for the whole or any distance is 2d. (4 cents). The diameter of the tunnels, or tubes, is 11 ft. 6 ins. and at the stations 21 ft. The stations are all higher than the level in the tunnels, the object being to gain a natural aid in checking the speed upon entering the stations.

The line was opened on Monday last, July 30, and has proved an immediate success. Many American innovations have been introduced in the general working and are appreciated by the passengers; the announcement by the conductors that the "next station will be ———," while amusing many, is much welcomed. The introduction of "choppers"—an arrangement whereby the possible loss of the passenger's ticket is obviated—is also likewise appreciated.

The success of the new railway will have immediate effect on the old underground lines, the sulphurous fumes in which have long been matter for comment and discontent.

Another point in favor of the new undertaking is that, as there is but one fare, the grades or classes (first, second, or third) of carriages, and consequent distinction of passengers, are eliminated.

The newspapers call attention to the fact that the new system has not only emptied the omnibuses, but has actually thinned out the crowds on the pavement. During three days, 260,000 passengers used the railway. They predict that in ten years London under ground will be a vast network of electric railways. Already there is projected a great belt of electric lines to encircle the metropolis, with intersecting railways to join the north and south.

The luxurious vestibule cars of which the company has one hundred and ninety, cost £1,000 ($4,866) each, and the twenty-eight torpedo-shaped engines were built in the United States for £3,000 ($14,599) apiece.

The working expenses of the line are calculated at £150,000 ($729,975) per annum, and it is estimated that if a fair dividend is to be earned 40,000,000 passengers must travel on the railway in the year. That represents a daily average of 110,000. It is believed this will be easily reached within the near future.

OSBORNE,
United States Consul-General.

LONDON, ENG.,
Aug. 3, 1900.

The Coulton Portland Cement Co. have purchased machinery to double the present output of the plant.

The American Cement Company has retired $35,000 of its bonds, leaving the amount now outstanding $965,000. The sinking fund calls for $30,000 annually.

The proceeedings of the Engineers' Club of Philadelphia, for November, 1900, contains an exhaustive article on the "Water Jet as an Aid to Engineering Construction," by Mr. L. Y. Schermerhorn.

Chili has just appropriated $500,000 for its exhibit at the Pan-American Exhibition to be held at Buffalo, N. Y., in 1901. The exposition is designed to bring the people of the entire continent into closer trade relations with each other.

The Cumberland & Potomac Cement Co. of Cumberland, Md., has contracted for erection and equipment of its proposed new works. The building will be of frame, sheathed with corrugated iron, 75 feet square, two stories high, to cost $40,000.

The Consolidated Cement Co. has let the contracts for improvements on their plant north of Whitefish Bay, Wis., to cost $25,000. Five new kilns, engine-house, mill and warehouse will be built.

A slag cement plant is to be erected at North Birmingham, Ala. The slag will be selected from the furnaces of the North Birmingham Iron Co. and the Sloss Sheffield Steel and Iron Co. The foundations for the mill are under way.

Articles of association for the Standard Portland Cement Co. of Detroit have been filed with the secretary of state of Michigan. The new company is capitalized at $1,000,000. George H. Barbour, president. The company owns 1,000 acres of shell marl beds at Hamburg Junction, Mich.

A Belgian stock company, with a capital of 1,500,000 francs, has just been formed in Egypt to carry on the manufacture of cement at Massara, on the Nile, near Cairo. This is the first enterprise of its kind in Egypt, which has hitherto imported cement in large quantities. The cement works of the company will be able to turn out about 120,000 barrels a year.

The Helderberg Cement Company of Howes Cave, N. Y., will operate its mills with water power, supplied by the Empire State Power Co., up to 1,000 horse power. The dry season has restricted the operation of mill for some time to one-half capacity. A steam power plant will be installed in order to keep the mill on full time during the dry season. The steam plant is to cost $75,000 or more.

Tne last yard of concrete in the walls of the Plaquemine locks was laid Nov. 17th. This lock is the largest piece of concreting in the world, containing 87,000 cubic yards, carried on a foundation of 9,000 piles driven in the ground forty feet. The walls of the lock are fifty-one feet in height and thirty-four feet thick at the bottom and twenty feet at the top. The inside measurement of the lock is sixty-five feet in width and 600 ft. long.

The concrete fortifications under construction by the German government at Metz have been changed to conform to the system designed by Gen. Brialmont of Belgium, which consists of a solid wall of concrete, 3 ft. 3 ins. thick, then an interval of 6 ft. 6 ins. which is filled with sand followed by a second solid wall of granite concrete, 10 ft. thick, reinforced by heavy cables. It is claimed that such a construction will resist the import of the best artillery projectile now in use.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	SEPTEMBER.				NINE MONTHS ENDING SEPTEMBER.			
	1899.		1900.		1899.		1900.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	15,567,430	64,870	2,969,184	10,816	52,268,415	200,315	85,482,747	333,626
Belgium..	14,014,763	43,862	15,087,449	49,663	161,091,735	486,605	213,546,822	633,884
France	297,645	1,122	587,200	2,562	4,420,045	15,524	11,713,088	41,880
Germany.....	46,662,412	159,151	46,058,287	173,059	329,495,178	1,162,414	356,812,392	1,338,484
All Other Europe ...	992,000	3,685	5,437,200	19,683	19,485,693	47,611	25,596,417	79,556
British North Am...	12,930	87	131,240	764	1,366,430	6,564	1,174,69[illegible]	6,266
Other Countries.....	.....	.....	2,660,430	11,156	9,602	145	9,144,680	39,749
TOTAL	77,547,180	272,777	72,930,990	267,703	568,137,098	1,919,178	703,473,836	2,473,445
Domestic Exports of Cements, bbls.	5,176	11,102	5,409	13,617	64,906	131,903	55,591	123,324

There were 1,412,784 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on September 30, 1899, valued at $5,674, against 11,398,572 lbs., valued at $38,266 in September, 1900.

Imports of asphaltum or bitumen for September, 1899, were 8,780 tons valued at $20,296; September, 1900—15,180 tons valued at $52,120. For nine months ending September, 1899, 75,069 tons valued at $232,846; for nine months ending September, 1900—86,266 tons valued at $309,470.

Incorporated: Stoddard Portland Cement Co., Detroit, Mich. Capital, $1,000,000.

A cement plant will be started on W. K. Rothenberger's farm near Reading, Pa.

Switzerland is now on the verge of over-production of Portland cement, and falling prices are the rule.

Cement is delivered at Zanzibar for $3.25 per bbl. of 350 lbs. It comes from Germany and England.

A new 600-barrel Portland cement mill is to be erected at Wellston, O. L. C. Vogelsang and L. F. Baines are promoters.

Incorporated: Charles W. Goetz Lime and Cement Company of St. Louis. Capital, $60,000. Incorporators, Louise A. Goetz, Marie E. Goetz, and Phillip J. Dauernheim, trustee.

Incorporated: The Truxell & Hensell Asphaltum Company of Chattanooga, Tenn. Capital stock, $100,000. The incorporators are C. H. Hensell, Ben. S. Truxell, A. E. Davenport, W. H. Ballew, S. B. Smith. The company has located a new asphalt deposit 65 miles west of Louisville, Ky., which they now own. The material will be refined at Chattanooga.

The District of Columbia is to have a cement storage warehouse from which all cement used on public works of the District is to be drawn.

A Keen's cement mill will be erected at Glade Springs, Va. Capital stock $50,000. Incorporators, T. Best, W. F. Dendy, P. A. Simmons and others.

The coal crushing and pulverizing department of the Portland cement Co. of Utah at Salt Lake City was destroyed by fire on Nov. 1. Loss about $4,000; fully insured.

A company is in process of formation at Quincy, Mich., to engage in the manufacture of Portland cement building stone, brick, tile, sills and caps and other building requisites.

Cement export and import has become a great business in Germany. It is shipped to nearly every country under the sun—South America, Asia, Australia—while the import is comparatively small.

Anyone desiring to secure tests of road material is directed to write the office of public roads, inquiry department of agriculture, Washington. They will be furnished instructions as to the manner of forwarding the material to be tested, and none not sent under the instructions will be given consideration.

The United States Department of Agriculture, Washington, D. C., is installing a laboratory for the examination and testing of road materials. The laboratory will be ready Dec. 1.

The Wm. Krause & Sons Portland cement plant at Martin's Creek, Pa., suffered by fire on the night of Nov. 26. Loss from $120,000 to $150,000. Insured. The fire originated in the coal house. The clinker grinding department was one of the buildings destroyed.

Articles of incorporation have been filed in Queen's county clerk's office, N. Y., for the Keene's White Cement Company, New York, with $10,000 capital. The works will be located at Long Island City. The directors for the first year are: Louis Fin, 87 Franklin street, Brooklyn; Max and Seymour Hermann, 161 West Ninety-Fifth street, New York.

The Peavey System of concrete elevators at Duluth, Minn., are about ready to receive grain. These elevators are cylindrical in form, 90 ft. high, constructed entirely of Portland cement concrete and steel rods. The storage capacity of the system, when completed, will be 3,000,000 bushels. The insurance on the grain stored in concrete elevators has been greatly reduced.

The Link-Belt Machinery Co.,

Engineers • Founders • Machinists, Chicago, Ill.

Designers and Builders of

LINK-BELT Elevators & Conveyors

FOR HANDLING

Limestone, Phosphate Rock, Cement, Sand, Ores, Lime, Gravel, Coal, etc.

MODERN METHODS,

Catalog No. 25,

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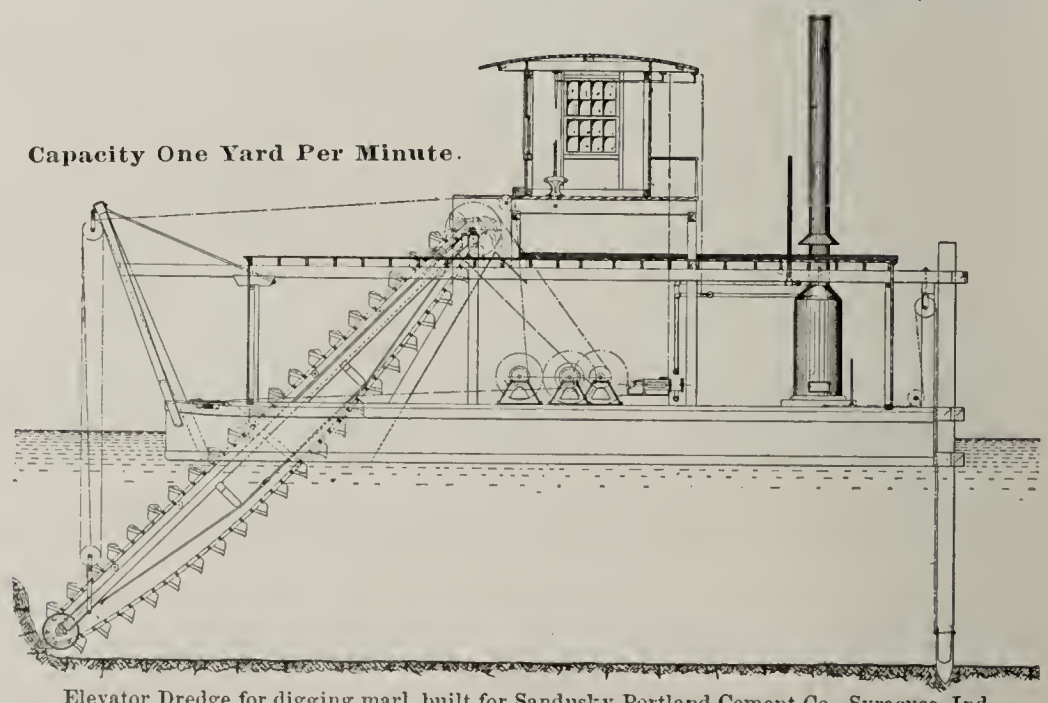

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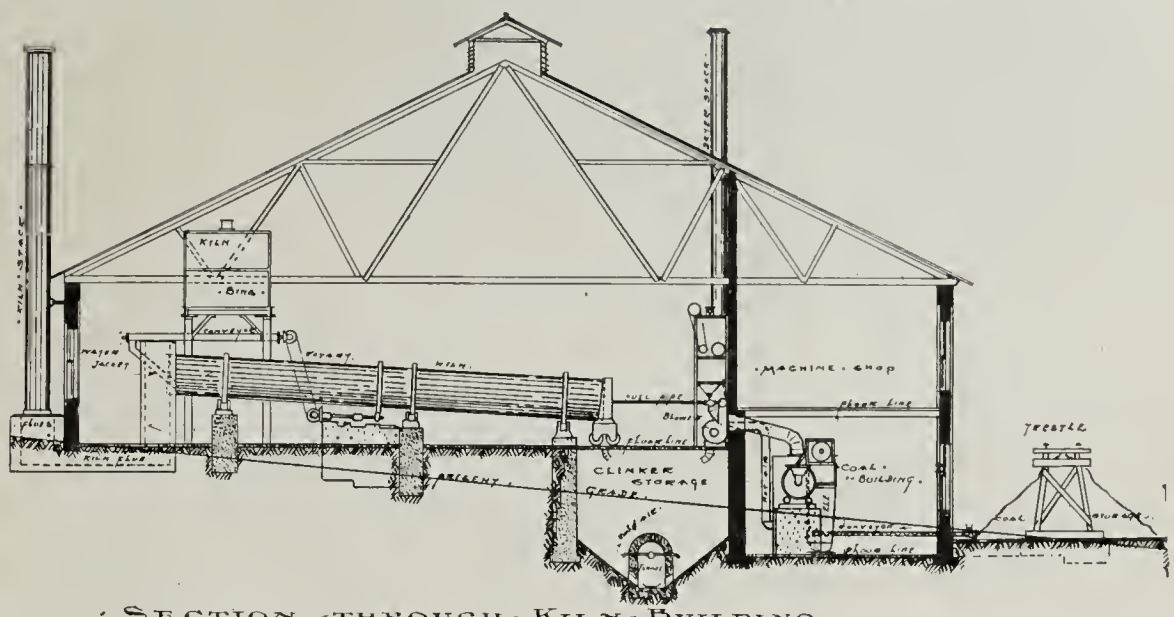

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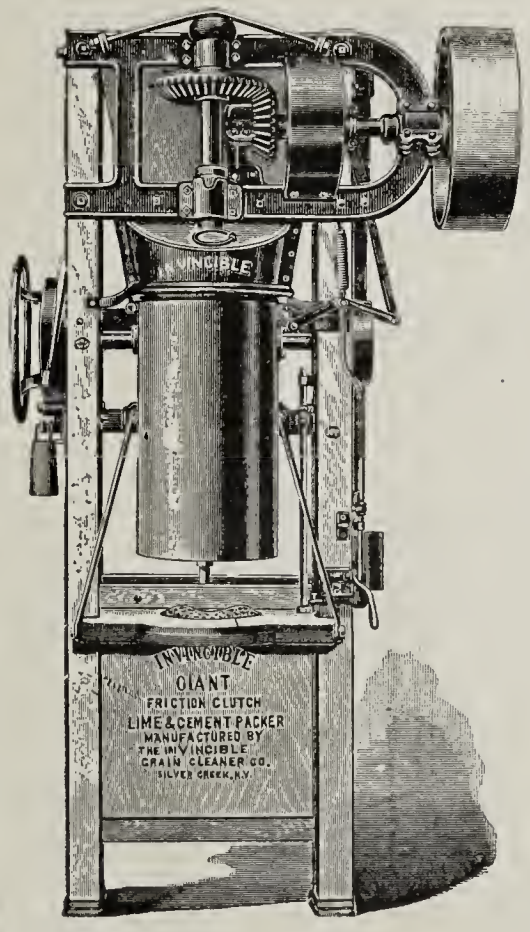

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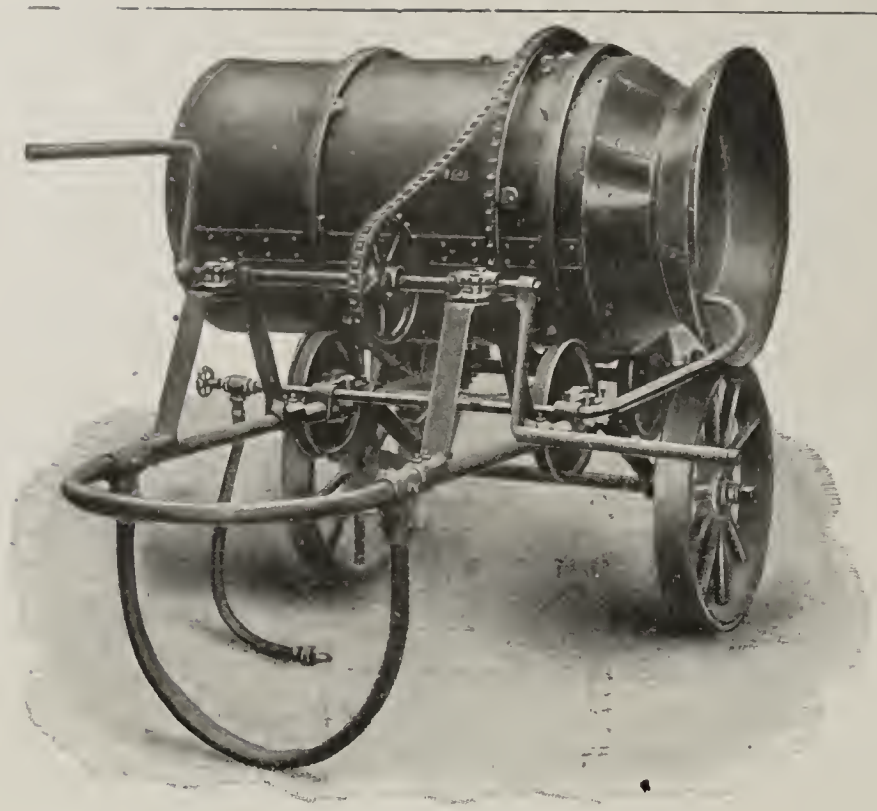

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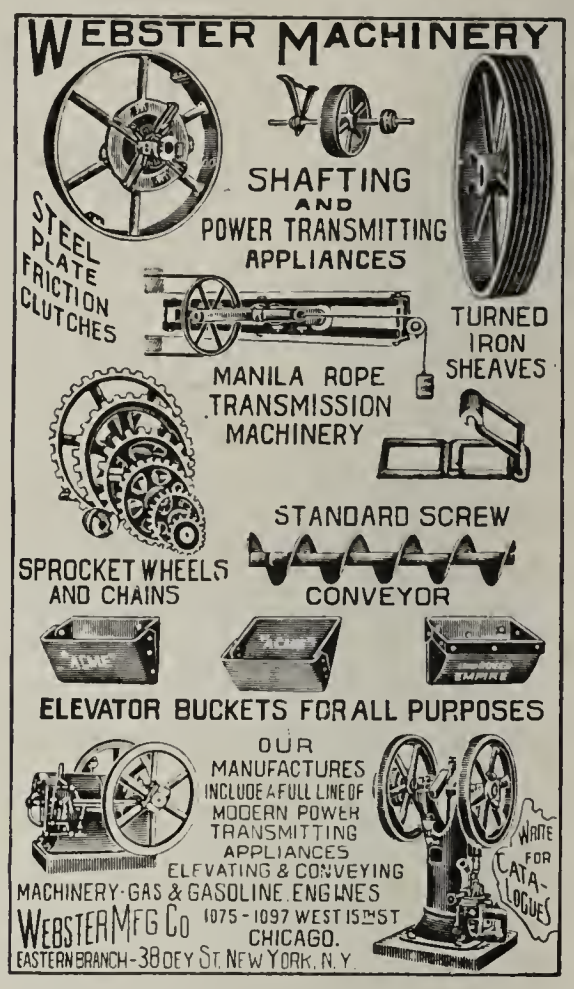

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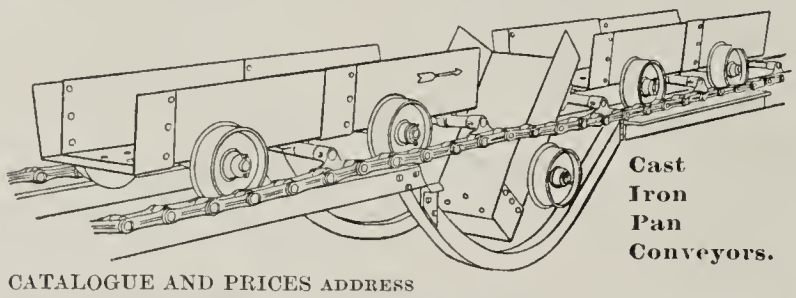

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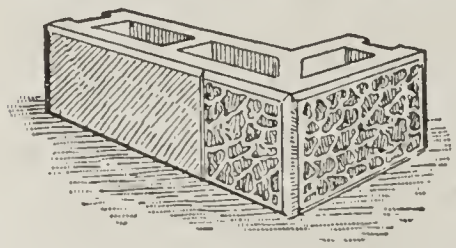

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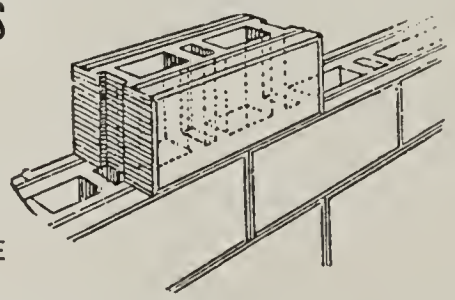

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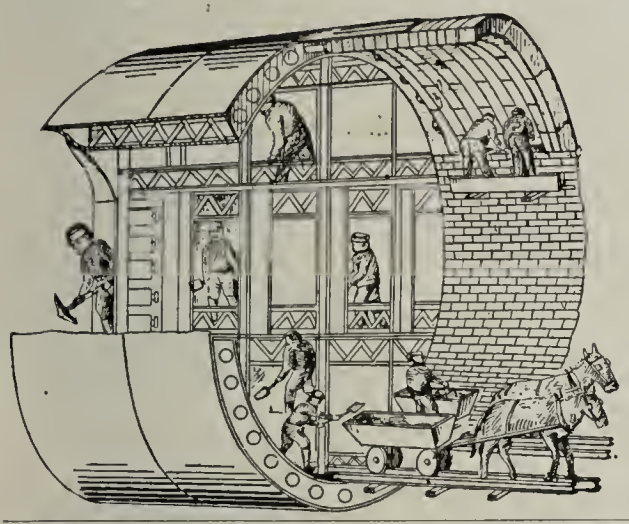

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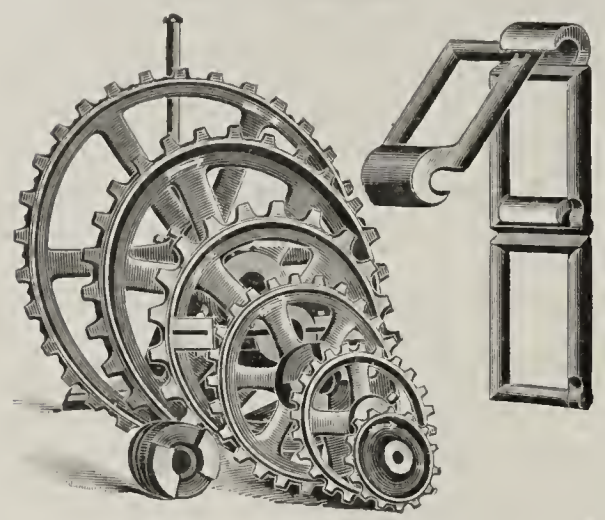

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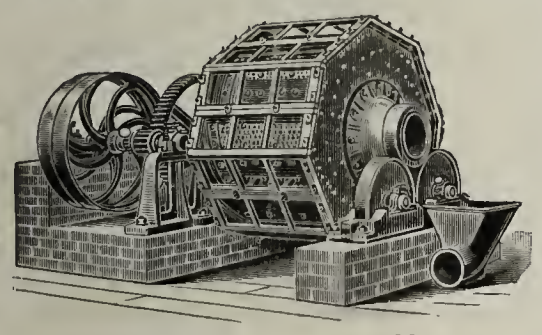

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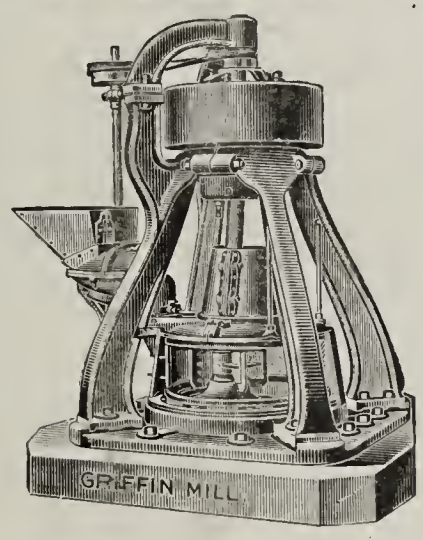

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The Peavey Elevator Company have been gathering data on concrete elevator construction, having sent its agents abroad during two successive years to make personal examination of concrete elevator construction as practiced in Europe. Their agents returned and devised a design of the details of their own, which is a radical departure from the Monier method of concrete elevator construction as practiced in Europe.

The Monier system has given uniform satisfaction in numerous concrete elevator constructions in Europe. The Peavey Company sought to avoid paying royalties to the owner of the Monier patents for the United States. After investing nearly $400,000 in a cluster of concrete elevators they find they have only a costly experiment in hand.

The Peavey Company sought not only to avoid the Monier patents by leaving out all perpendicular steel rods, as well as changing the form and distribution of imbedded horizontal rings, but by substituting Portland cement concrete instead of Portland cement mortar for the elevator walls, all of which resulted in weakening the construction, causing a complete break and collapse between three circular bins, covering an area of more than 1,000 square feet.

This misfortune has resulted in calling off several large concrete elevator projects, for which contracts were about to be let, thereby resulting in a direct injury to the American cement industry, which must, however be only temporary. When the parties in interest are able to discriminate between proper and improper methods of construction, capital will not hesitate to freely embark in concrete elevator construction.

CHICAGO BRICK TRUST ILLEGAL.

The Cook County Brick Company, a trust in control of the sale of brick in Chicago and Cook county, has been a potent factor in local politics and has shaped legislation in the interest of the brick trade; in more than one instance it has prevented the use of concrete sewer construction in Chicago in order to exact an excessive price on each thousand of brick sold to the city and private consumer. This company holds leases on forty-five brick yards in Cook county, paying nominal sums only for each lease. For instance, on the Laban brick yard, having a capacity of 21,000,000 per year, it pays $13.00 per annum rental. It immediately re-leases the yard back to the owner and exacts a tribute of $1.50 for each thousand brick made, amounting to $31,500 per year. This sum is subject to forfeiture should the owners violate conditions in their leases from the Cook County Brick Company. The courts have now declared these leases to be subterfuges designed to operate and maintain a trust for the sale of brick in Cook county, and therefore illegal. This ruling is just and should result in giving Portland cement a fair and even field in Chicago public works, from which it has been systematically debarred by the brick trust.

The Vulcanite Portland Cement Company has opened an office at 317 Chamber of Commerce Building, Chicago, in charge of Mr. George W. De Smet as Western Sales Agent. Mr. De Smet has been identified with the sale of "Vulcanite" brand throughout the West for the past four years.

The origin and extended use of asphalt pavement is said to be due to Emperor Napoleon III who requested French engineers to provide a pavement that could not be torn up by the disorderly element of Paris and used for either building barricades or hurled at the troops during periods of riot. Hence asphalt pavements were laid and found to answer every condition imposed by Napoleon, who at once ordered all the principal streets and avenues of Paris to be paved with asphalt, as a military measure, and thus a great industry has been founded on the primary object of suppressing mob rule.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	OCTOBER.				TEN MONTHS ENDING OCTOBER.			
	1899.		1900.		1899.		1900	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	8,533,141	31,953	778,800	2,953	60,801,558	232,268	86,261,547	336,573
Belgium..	42.024 553	111,870	51,613,021	162,194	203,116,288	598,475	265,159,843	796,078
France	1,237,800	4,307	.....	.....	5,657,845	19,831	11,713,088	41,880
Germany.....	55,827,605	197,343	48,122,116	176,521	385,322,783	1,359,757	404,934,508	1,515,0 5
All Other Europe ...	2,521,600	7,210	3,162,400	8,188	22,007,293	54,821	28,758,817	87,744
British North Am...	237,660	1,471	599,846	2,931	1,604,090	8,035	1,774,536	9,197
Other Countries.....	800,000	3,848	400,000	1,666	809,600	3,993	9,547,680	41,415
TOTAL	111,182,359	358,002	104,676,183	354,453	679,319,457	2,277,180	808,150,019	2,827,898
Domestic Exports of Cements, bbls.	4,795	11,287	8,715	19,073	69,701	143,190	64,306	142,397

There were 851,303 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on October 31, 1899, valued at $3,073, against 14,657,658 lbs., valued at $49,145 in October, 1900.

Imports of asphaltum or bitumen for October, 1899, were 10,529 tons valued at $31,481; October, 1900—8,626 tons valued at $24,213. For ten months ending October, 1899, 85,598 tons valued at $264,327; for ten months ending October, 1900—94,982 tons valued at $333,683.

THE DITTRICH APPARATUS FOR THE DETERMINATION OF THE CARBONATE OF LIME IN THE CEMENT RAW MIXTURE.

By Dr. W. Michaelis, Jr.

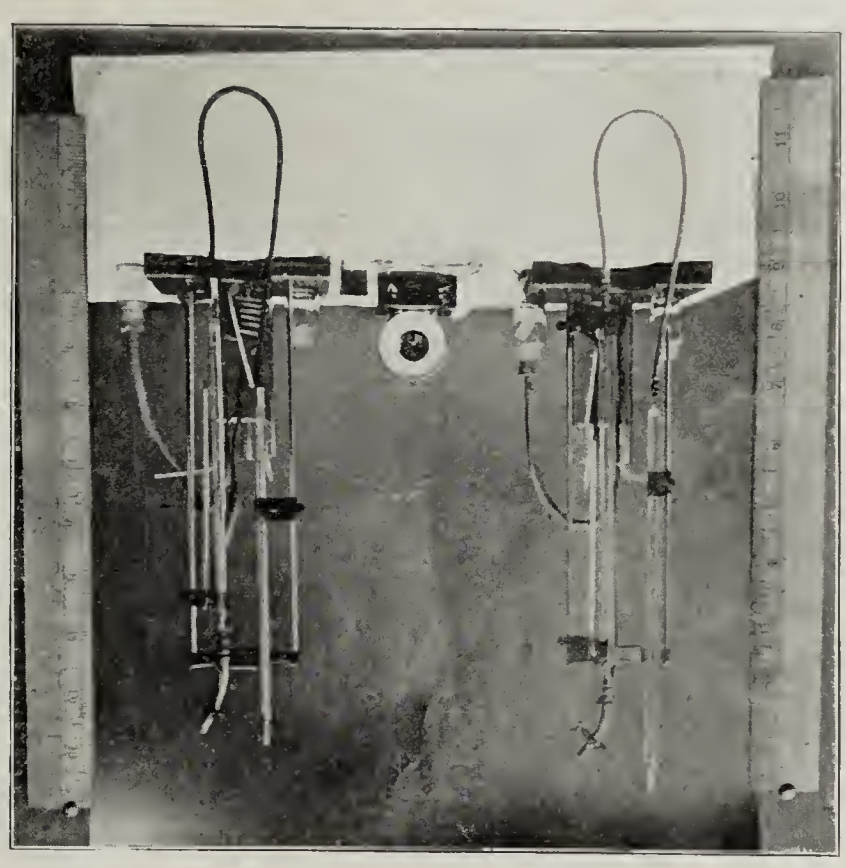
In a former issue of this magazine, Vol. VIII, No. 6, I mentioned the methods employed for the determination of carbonate of lime in the cement raw mixture and recommended the Dittrich apparatus as preferable to Scheibler's calcimeter.

In the following I give a detailed description of the Dittrich apparatus and its operations and believe thus to prove the best the advantage of this calcimeter over any other method for the controlling of cement raw mixtures.

DESCRIPTION OF APPARATUS.

The apparatus rests on a wooden base in which two iron rods are set. In front of the apparatus are two glass tubes attached to the iron rods by brass clamps; the tube on the right of the operator, the one on which the gas volume developed is noted, is graduated to 100 cc., each cc. being again subdivided into five parts. This tube is held by two brass clamps in order to secure a perfectly vertical position; it always remains stationary, while the one on the left, called the equilibrium tube, is held only by one clamp, which is slid up and down at the will of the operator.

The substance to be tested for carbonate of lime is brought into a gas generating bottle of about 150 cc. capacity placed on the right side of the operator. With the substance is placed in the gas generating bottle a small tube of 10 cc. capacity filled to the 5 cc. mark with hydrochloric acid of the specific gravity 1.125. This gas generating bottle is closed by a rubber stopper through which passes a small glass tube which is connected by a rubber tube with a lead coil within a glass cylinder filled with water. The connecting rubber tube must be so long that the gas generating bottle can easily stand on the operating table and can be placed from there into the water cylinder upon the lead coil. This cylinder is placed upon the base directly behind the iron rods and glass tubes above described. The other end of the lead coil is connected by a rubber tube to a branch of the graduated tube. Placed on the upper end of the graduated tube is a short rubber tube fitted with a pinch-cock. The graduated and equilibrium tubes, which are of equal length, are connected at their lower ends by a strong india rubber tube about three feet in length protected by a coil of copper wire. Both the graduated and equilibrium tubes are half filled with mercury. Two thermometers and a very accurate barometer belong to the apparatus; one thermometer serves to measure the temperature of the operating room, while the other gives the temperature of the water in the glass cylinder. The temperature of the atmosphere and of the water in the cylinder must be strictly co-incident, so that the gas generating bottle, the lead coil, and all parts of the apparatus have the same temperature.



THE DITTRICH APPARATUS.

DESCRIPTION OF OPERATION.

The apparatus is placed opposite a window, on the edge of a table, so that the operator is able to see through the apparatus toward the window and can easily read off the divisions of the scale on the graduated tube.

First, the tightness of the apparatus must be tested: An empty gas generating bottle is connected with the apparatus and the equilibrium tube is raised so that the mercury stands at the zero mark of the graduated tube, then the short rubber tube at the upper end of the graduated tube is closed by the pinch-cock. Now the equilibrium tube is lowered until the mercury stands about at the middle of the graduated tube. By this a partial vacuum is formed in the gas generating bottle, the lead coil and the upper end of the graduated tube and the mercury stands higher in the graduated tube than in the equilibrium tube. If the apparatus were not tight the mercury would soon fall until equilibrium was established between the tubes. The height of the mercury is read and it is observed from time to time if it remains at the same point. If the height of the mercury remains constant after a few minutes the apparatus is tight and ready for use. This test of the tightness of the apparatus should always be made before using.

The substance to be examined must be finely ground and dried at 105 deg. centigrade, the position of the barometer and thermometer are read, and on the large table accompanying the apparatus the weight corresponding to the readings of the barometer and thermometer is found. Thus for the barometer reading of 744 millimetre and for a temperature of 22 deg. centigrade the figure 3943 is given in the table. This means that 0 3943 gram of the substance must be weighed.

The weighing is done on a brass plate counterpoised by a brass hook placed on the other pan. The weighed substance is then transferred to a well-dried gas generating bottle by means of a fine squirrel's hair brush. A small tube containing 5 cc. of hydrochloric acid is also placed in the bottle by means of crucible tongs. Great care must be taken that no acid adheres to the outside of the tube and so attacks the substance before the apparatus is ready for use. The temperatures of the room and the water must be taken again in order to ascertain if they remain constant.

The gas generating bottle is placed on the table and held by the neck, while the stopper is placed firmly in it. Then the equilibrium tube is adjusted so that the mercury stands at the zero point and the rubber tube is closed by the pinch-cock. Now the operator holds the clamp of the equilibrium tube loose in his left hand, while with the right hand he grasps the neck of the generating bottle; by a quick motion he turns the bottle so that the contents of the small glass tube are emptied into the bottle without touching the stopper.

At once carbonic acid gas is gener-

ated, depressing the mercury in the graduated tube. As fast as the mercury falls in the graduated tube the equilibrium tube must be lowered by the operator until the mercury ceases to fall. The equilibrium tube is now fixed so that in this tube the mercury stands a little higher than in the graduated tube. The bottle is shaken so that the acid comes in contact with the whole substance and is then placed in the water cylinder. After a minute the bottle is taken out and again shaken and replaced in the water. By the warmth of the hand and by the chemical reaction the temperature of the contents of the bottle is raised; it must therefore be placed into the water to regain its former temperature.

The developed gas volume must not be read until two minutes after the pouring of the acid on the substance. The reading is done after bringing the two columns of mercury to the same level.

To the volume of gas thus determined must be added the gas absorbed by the 5 cc. of hydrochloric acid; this volume of gas absorbed varies according to the entire volume evolved and is found on a special table in which the generated gas and its corresponding absorbed gas volume is given.

The addition of the two volumes gives the percentage of the carbonate of lime in the substance.

CONCLUSIONS.

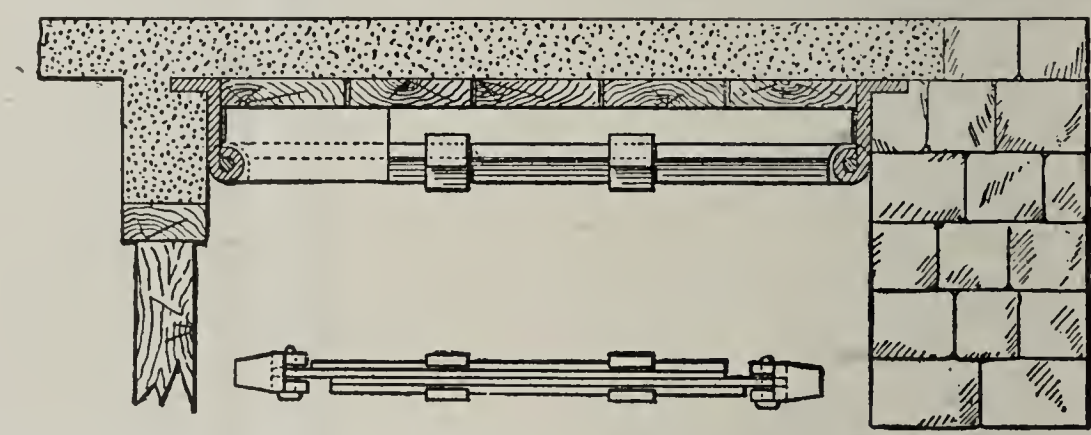
This apparatus enables to determine accurately within five minutes any percentage of carbonate of lime in a given chalk, marl or in the cement raw mixture. The larger of the tables accompanying the apparatus gives the quantity of the substance which must be weighed off for each special barometer and thermometer reading, so that the gas volume evolved gives immediately the percentage. In this way no calculation, neither before nor after the determination is necessary.

The smaller table serves to indicate the quantity of carbonic acid absorbed by the 5 cc. of hydrochloric acid used to decompose the substance. This absorbed volume is within the limits of from 0 to 3 cc. according to a development of from 0 to 100 cc. and the fact that this varying gas volume is determined by tests for every apparatus and given on a special correction table forms the essential advantage of this apparatus. Scheibler adds in his calcimeter always 3 cc., the average figure of the 0 to 6 cc., which are absorbed by the 10 cc. of hydrochloric acid used in his apparatus for the decomposition of the substance. Besides the Scheibler apparatus possesses no contrivance to keep the temperature at the gas-generating bottle constant.

CONCRETE EXTENSION SUPPORT.

For sidewalk and floor construction (arched or flat.)

The device consists of two pieces of rolled steel tees. Each tee has a hinged bracket at one end. The tees are assembled and held together by clamps which embrace the lower half of the web as well as the entire flange or rip on each side. The support is placed in position as shown in the illustration. The false work in this instance consists simply of planking resting on upper flanges of the tees. Where arch work is to be made the centering is carried on the extension supports distributed along the work. As soon as the work has hardened



the two clamps are driven to one side, until one of the tees is released when both drop to a perpendicular position. The false work can then be readily removed and used in connection with the supports on some other portion of the work. This device can be lengthened and shortened for different widths of span. It is extensively used in France, where it is known as The System Perret, after the name of the inventor, Marc Perret a Belley (Ain) France.

A cement plant is projected at Salt Lake, to be located in Parleys Canyon, Utah.

The New England Portland Cement Co. has been organized, with head office in Jefferson county, W. Va., to manufacture lime and cement. Subscribed capital, $1,000, of which $100 has been paid in, with the privilege to increase the capital stock to $500,000. The stockholders all reside in New York city.

At the annual meeting of the directors of the Coldwater and Quincy cement factories at the office of the Coldwater factory, Nov. 27th, officers for the coming year were chosen as follows: President, L. M. Wing, Coldwater; Vice-President, S. H. Basset, Chicago; Treasurer, W. L. Holmes, Detroit; Secretary, E. R. Root, Coldwater. Following is the board of directors: L. R. Taylor, Adrian; S. H. Bassett, Chicago; J. T. Holmes, W. L. Holmes, Detroit; L. M. Wing, Coldwater. The company will move its headquarters from Detroit to Coldwater.

Nature gave men business capacity, advertising sets it to work.

The Lawrence Cement Co. removed $25,000 worth of machinery from its Whileport quarry in order to save it from being covered by a cave-in of the quarry.

The Buckhorn Portland Cement Co. of Manheim, Preston county, W. Va., has made an assignment. $165,000 has so far been expended on the plant. Abram C. Mott of Philadelphia is receiver under a $50,000 bond. Pennsylvania people hold $175,000 of the company's bonds; $60,000 will be required to complete the plant; the company owns 1,000 acres of land.

DULUTH ELEVATOR ACCIDENT.

CENTRAL TECHNICAL BUREAU,
MONIER CONSTRUCTIONS,
CHICAGO, Dec. 18, 1900.

MR. WM. SEAFERT,
Editor *Cement & Engineering News:*
Chicago, Ill.

DEAR SIR:

Replying to your favor of even date, regarding the accident at the Peavey elevator in Duluth, will state, that although the arrangement and general outline of the tanks were according to my plans and suggestions, the detailed construction was executed by a Minneapolis contractor by the name of Mr. Haglin, who, contrary to my specifications, suggestions and warnings, built the tanks without vertical rods, and in horizontal layers without bond. Furthermore, the tanks were built of concrete (1¼ cement, 2 sand, 5 gravel), whereas the Heidenreich-Monier system uses a strong cement mortar which gives a better silica connection between the steel and the cement. This was a fatal departnre and has certainly given Monier cement tanks a serious blow in this country, as but few people will realize that the Duluth tanks were built without the proper engineering specifications and supervision. Mr. Peavey at Duluth, in attempting to avoid the approved system of Monier construction, has been experimenting in a manner which will prove very costly to himself, and at the same time cast an unwarranted suspicion on the proper Monier elevator construction.

Yours very truly,
E. LEE HEIDENREICH.

The buildings of the Newaygo Portland Cement Co. are about completed. The company has encountered much unlooked-for trouble, expense and delay in trying to reach hard pan for the foundations of its 1500 H. P. water power dam, one section of this dam having repeatedly given way during construction.

CALIFORNIA PORTLAND CEMENT.

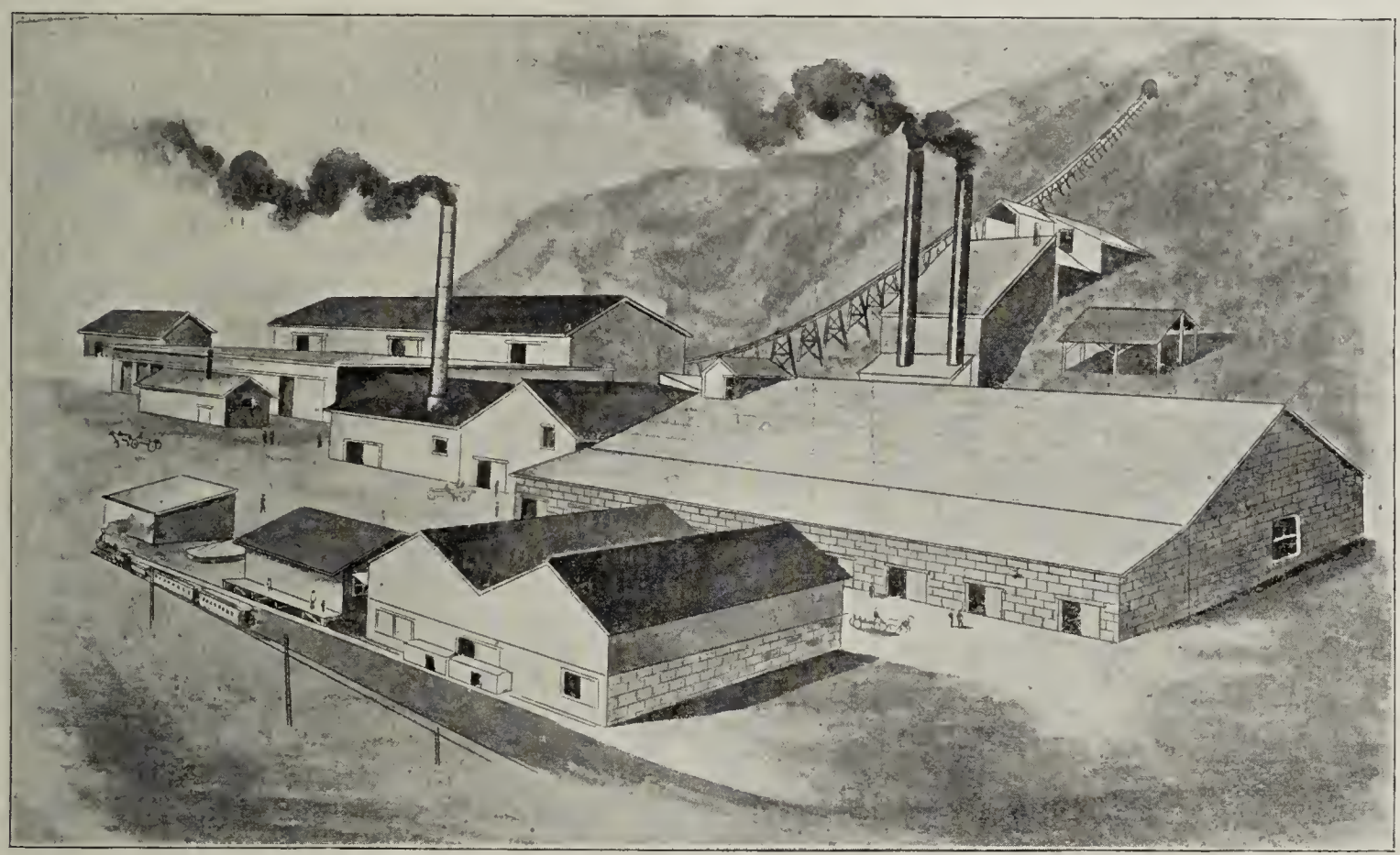
The plant of the California Portland Cement Co. was erected at Colton, Cal., in 1893. Several features of the local cement market made the introduction of the California cement difficult. All the cement previously used in the state had been imported and consumers had an idea that no Portland was made or could be made in this country. Some contractors and masons still believe this to be a fact.

Some ten or fifteen years ago Portland cement works of the old European type had attempted to manufacture cement at Santa Cruz and at Jamul, near San Diego, by making the raw material into brick and burning these in a dome kiln with Australian coke for fuel, then grinding the clinker with French buhr stone mills. These works had failed, principally on account of the expensive fuel and labor. Then the market for Portland cement in Southern California is quite limited, only about 125,000 bbls. being used annually. Of this the Colton works have, during the past two years, sold about half, supplying nearly every engineering work of any magnitude undertaken during that period. Only the small contractors, with life-long predispositions in favor of foreign cement, or without means of having his cement tested, continues to pay a dollar per barrel extra for foreign cement. The Colton works are about three-quarters of a mile from the railroad station and the two railroads, the Southern Pacific and the Atchison, Topeka & Santa Fe have tracks to doors of the warehouse. The location, on the slope of Slover Mt., enabled the constructors to utilize gravitation for conveying materials.

An extensive ledge of calcite stands on edge in the heart of the hill and this furnishes the lime constituent of the cement. The quarries are half way up the hill. At the quarry the rock is loaded into cars, hauled by burros through a tunnel four hundred feet long, then dumped into a chute three hundred and seventy feet long down the side of the hill that delivers it at the crusher on the upmost terrace of the mill. The limestone is put through a jaw crusher first, then passed over a jig-conveyor with a gridiron screen that removes the finely crushed rock, while the coarser rock gravitates to a small Gates crusher. After reduction to nut size all the rock is delivered to a storage bin located below the crusher terracee, but above the mixing and grinding room.

The clay pits are at Perris on the Santa Fe railroad, about thirty miles from the works. The clay is air-dried at the pits by plowing up large patches and exposing it for weeks to the dessicating California atmosphere. It is delivered at the works in cars and unloaded into large storage bins of 5,000 yds. capacity. A small car and incline serve to elevate the clay as required to a small bin alongside the bin for crushed rock and above the mixing room. On account of the dryness of the climate and materials, drying kilns are not used either for rock or clay.

On the terrace below the rock and clay bins, are located the mixing room with a battery of four Griffith mills for grinding the raw materials. A steelyard of fifteen hundred lbs. capacity, with a dumping hopper, is mounted to swing readily in several directions. It is swung under the rock bin, a charge drawn then swung under the clay bin, a charge of clay drawn, then it is swung over a hopper below the floor, that discharges into an elevator boot. The first mixing is done in discharging the rock and clay into this elevator boot. The elevator spouts the material into feeding hoppers above the Griffin mills. The mills reduce the raw mix to the required degree of fineness and deliver it to the screw-mixing conveyors that discharge into large storage bins underneath the floor of the mixing room. As a check on the mixing and to standardize the raw mix it is sampled at the mills every half hour and tested for its lime percentage. Beneath the raw mix storage bin is a screw conveyor operated automatically by counter-shafting belted to one of the roller shafts under the rotary kiln. This conveyor feeds the raw mix to the kiln at any rate desired by the burner in charge, the regulation being effected by shifting a belt on a coned pulley.



CALIFORNIA PORTLAND CEMENT COMPANY'S WORKS, COLTON, CAL.

The next lower terrace has a kiln shed with two rotary kilns, each seventy-five feet long and of special design. Petroleum is used for fuel. It is fed into a gas producer opposite the end of the rotary. The blast is from individual fan blowers that require but little power to run and admit of using a hot blast. These and other features of the process are covered by the Duryee patents and enable the works to produce economically a product that stands very high tests, and this from rather refractory raw materials.

On a level with the kiln building is the clinker cooling shed. Descending ten feet the level of the engine, boiler and dynamo house is reached. Both steam and electric power are used. A portion of the electric power is taken from the Redlands Electric Light & Power Co. and part is generated at the works.

The kilns and blowers are run by individual steam engines, the crushers and mills in the raw material department are run by a motor set in an adjoining room. The shaft of the clinker-grinding room is run either by the engine or dynamo, the shaft being so coupled that a change from one power to the other can be made instantaneously. The dynamo is also run as a motor when taking power from the Redlands Power Co. The buildings are lit by electricity.

Krupp ball and tube mills are used in reducing the clinker. An objection to the tube mill arose from the excessively high cost of Greenland flint pebbles due to the high transcontinental freight rates. The original and only invoice of those pebbles received cost $45 per ton delivered at the works. Afterward California pebbles were found at a short distance from the works. They are quartz, not so perfect in shape or size as the Greenland pebbles, but they have proven equally satisfactory for grinding purposes and they cost $6 per ton for the hand selected quality. Perhaps some of the Eastern cement manufacturers could secure American pebbles from local deposits, from pebbly beaches for example. The stockhouse bins are on a level with the mill room and have a storage capacity of 40,000 bbls. in bulk in eight bins. A screw conveyor takes the cement from the stockhouse to the shipping warehouse where it is sacked. Several thousand barrels are kept sacked ready for shipment. The capacity of the plant is three hundred and seventy-five barrels a day.—E. Duryee, Chemist, California Portland Cement Co.

Mailed on Application.—"Hand-Book of Useful Information for Cement Users." Compiled by E. Duryee, C. E., Portland Cement Specialist, Colton, Cal.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the Cement and Engineering News.

MOLECULAR STRUCTURE OF PORTLAND CEMENT.

In the realm of things which the eye cannot discern, theory and hypothesis must play an important part in leading to useful conclusions, and only gradually do the truths become more evident, for which men are seeking earnestly.

Especially is this true in the field where the ultimate atomic forces play. Small as are the elements they are of great magnitude when viewed from a single point of the field throughout which their forces are exerted. Whatever an atom may be, each one is a character in itself. It will do certain things in certain circumstances, and with greater or less intensity of action. So in forming a cement we depend upon the character of the atoms and arrange for them conditions which enable them to do certain things.

To understand these certain things is an important and entertaining feature in the chemistry of cement. No hypothesis, no demonstrated formula, has yet been able to explain all the intricate and confusing things in the behavior of cement materials. No one knows what is yet to appear, but mind is moving forward in this matter and new methods are opening the way to larger understanding. There are some points, perhaps not yet demonstrated beyond all contention, but which stand out with prominence sufficient to be suggestive. These things seem to point in one direction however disconnected their occurrence may be.

Two things seem to be essential to form Portland cement, viz., an oxidizable base and a completely oxidized acid of such character as will not volatilize at high temperatures and not fuse at low temperatures. This seems a common observation, but it seems as narrow as present knowledge will justify. This will include iron and manganese oxides, both readily oxidizable bases; alumina, inoxidizable and infusible; barium, stroutium and calcium oxides, highly infusible and difficult oxidizable bases; and silica, an inoxidizable and highly infusible acid. Of these only lime, iron oxide, alumina and silica are commonly associated in commercially paying quantities, and with these we have to deal in many ways. We are familiar with them in limes, cements, slags, brick and pottery, and from observation of their action in the production of all these we gain an insight into their character which is useful in the most intricate investigation of all, that of the nature of Portland cement molecule.

What are the steps to its formation? What is its structure, and what are the chemical actions in its transformation into stone? What, in the nature of its elements, aids its perfect formation, and why?

These are pertinent questions for the cement manufacturers, and yet they are but lightly investigated by most of them. They grope after results in chance ways, and hold onto the practical results obtained, until finally they can classify these into rules of action. Some succeed and many fail, and the failures are easily charged to ignorance or misjudgment, while often the successes must be credited to chance.

What are the salient points in the characters of these elements that have most significance in Portland cement manufacture?

Iron Oxide is a ready flux, is easily oxidized or reduced. At moderate furnace temperatures combines easily with silica as monoxide, to which it is reduced from the redoxide. At high temperatures it is easily displaced by stronger bases and if it can secure oxygen will return to the sesquioxide state. If at still higher temperatures a free base of greater affinity for oxygen deprives it of its supply it may even volatilize until it can secure the needed oxygen. At the very high temperatures the sesquioxide may act as acid in presence of a strong base, but these compounds are not permanent at ordinary temperatures.

Alumina is infusible and difficult to flux at ordinary furnace temperatures. At higher temperatures it may displace iron oxide in combination with bases, but as temperature rises higher it will itself be displaced by silica. In the presence of an excess of bases it will form aluminates which, at ordinary temperatures, are unstable. It is notoriously inert and, when in combination, is equally unstable, exkept as silicate. An excess of iron and alumina in furnace mixtures tends to formation of ferrous aluminates, compounds which are easily decomposed. Silica is an acid of most stable character at all oxidizing temperatures and of great affinity for bases at high temperatures, its compounds with lime, magnesia and alumina being the most stable and infusible materials of our rocks and soils. Its compounds have a great affinity for water, forming by solution or combination and crystallization the great body of the crystalline minerals of the globe.

Calcium Oxide is a most infusible mineral. It can be readily oxidized in solution or at high temperatures. It has a great affinity for silica at high temperatures, and for water at ordinary temperature. The higher oxides are not stable compounds and do not exist at ordinary temperature, except in solution. The formation of higher oxides produce heat and their dissociation absorbs heat. The form-

ation of Calcium Hydrate produces heat also. The hydrate may be crystalline or amorphous.

Associated with these minerals we may find magnesia, which, in many limes, comports itself similarly to calcium oxide, and in many silicates may be substituted for it. It is significant to note, however, that it belongs to a class of elements which have, throughout all ordinary limits, a single oxide form, and that its salts differ essentially from the corresponding salts of lime.

It may be noted that some salts of lime exist in nature in the higher oxide forms, as fluorides and bicarbonates, and that its salts follow two systems of crystallization. Soda and potash, even in very small percentage, have large potency in lowering the fusing point of mixtures of these substances, and in the presence of strong acids yield their places in combination with silica to weaker bases at high temperatures. All these and many more natural characteristics play their essential parts in the formation of the Portland cement molecule.

The Portland cement molecule depends thus on many things for its formation, and in its own action is affected by many things, but in itself it is an organism, distinct and characteristic, more or less intense in its activity, more or less contaminated by or segregated from the substances with which it is commingled From this point on we mingle fact and theory—things seen and known with things unseen but believed.

The molecule essential to Portland cement is called Tricalcium Silicate. This signifies evidently that three molecules of Calcium Oxide are combined with one of Silica. It represents correctly the numerical ratio of molecules present in the organism, but it goes no further. It seems to me erroneous, or at least misleading, for I do not believe there is anything to indicate that three molecules of lime are combined with one of Silica, or if they are there must be a very vital difference in the method of union or the affinities exerted. And, if there is a difference there should be a distinction. The name should indicate the structure. To represent my own conception I should call it tetra calcic silicate of lime. This would indicate that the ordinary silicate of lime, $2\,CaO.SiO_2$, is combined with calcium oxide in the tetrad state, formed by the displacement of one atom of oxygen from calcium dioxide by dicalcium silicate, and should be written $2Ca{=}O.SiO_2,Ca{\equiv}O$ or $2CaO^2.SiO_2,Ca^4O$. This distinction I consider vital to a conception or clear understanding of the phenomena of the formation, decomposition and and re-crystallization of the cement mass. It brings in an element hitherto neglected—an equivalent of one atom of oxygen—and makes a logical distinction between the lime of the dicalcium silicate and the lime addition to the molecule which comports itself so differently from that of the common silicate. In the presence of water the latter may gradually hydrate, but decomposition and hydration of lime does not occur. Many phenomena have shown that the additional lime of the tricalcic silicate is readily removed from its association by water and other solvents and that dissociation is hastened or retarded by the presence of other salts and by the temperature and duration of the incineration to which the molecule is subjected when formed. When once the distinction is admitted these phenomena are naturally to be expected. There is a world of suggestiveness in this conception of the molecule. How can a third molecule of lime enter this compound differently from the two of the original silicate, unless it enter in the tetrad state? Theory consistently offers no alternative. Can this material be produced in the furnace under conditions that will not furnish lime in this state? Practice all goes to show that it cannot.

If this state is essential then those materials which furnish lime in a state most readily oxidizable would give the best results in manufacture, and if inferior material be used the addition of a portion of lime readily oxidizable and in a state which would not be affected till after a temperature is reached that forms dicalcium silicate, would improve the quality of the cement. Practice lends confirmation in the use of barium salts and sulphates and fluorides of lime.

Hence it is to be expected that sedimentary lime carbonates deposited in place by precipitation from water super-saturated with lime, bicarbonate would yield the most perfect material for making cement. Such deposits may become solidified to any degree with little loss of excellence, but if they be metamorphosed and crystallized by heat and pressure and impregnation of water after the nature of magnesian rocks, the production of a high grade of cement will be rendered correspondingly difficult.

If this conception of the cement molecule be correct, a ready solution of the magnesia problem is suggested. It is probable that a considerable amount of magnesia can be substituted for lime in the dicalcium silicate molecule without materially altering its character. But as magnesia is not readily oxidizable, it could not be substituted for the tetrad lime in the tricalcium silicate. If, however, the magnesia lime silicate be first produced the tetravalent lime can be combined with it and act for many purposes the same as with dicalcium silicate. Some materials might respond readily to this requirement, and others not at all. Hence the conflicting results of experiments in this line, and the occasional high quality of cement containing high percentages of magnesia.

The setting of cement is undoubtedly due to the tetrad lime. A quantity of water chemically equivalent to the amount of this lime will produce a full set. Any additional amount is superfluous for setting purposes. The affinity of the displaced radicle of dicalcium silicate may be gradually supplied with water, with increase of strength and density. The more perfect the molecule, the more marked the increase of strength with hardening. The more rapidly the hardening takes place, the earlier the full strength is attained. Rapid setting and quick hardening are not inconsistent with perfect cement, in the sense of chemical perfection. If such cement be defective it is due to deficiency of tetrad lime or excess of free lime. Rapid setting and slow hardening may go with the former, or slow setting and rapid hardening with the latter. All kinds of variations may occur.

If heat be produced by the forma- of calcium dioxide—and the substitution of the dicalcic silicate for one atom of this oxygen—as indicated by the formation of a more infusible, instead of a more liquid body in the kiln—then, on the liberation of this molecule by hydration, we should find an equivalent amount of heat absorbed. That the heat furnished by the hydration of the lime should disappear, and that crystallization without change of volume or temperature should occur, is not all anomalous.

In view of this constitution of the molecule, the steps to its formation are plain and lucid. By whoever will carefully observe the reactions of the rotary kiln, these steps can be quite clearly marked. After the carbonic acid is driven off and the ferrous oxide has combined with silica, a point of temperature is reached where the mass becomes plastic and gummy. At this point the ferrous oxide is gradually displaced by lime. Until all the silica is combined with lime this ferrous oxide acts as a carrier between the lime and silica, producing dicalcic silicate. As soon as all the ferrous oxide is not required for this transference it gradually becomes oxidized to sesqui-oxide. It then becomes a carrier for oxygen to the lime. Where this occurs a violet flame plays on the surface of the

mass, and as the calcium oxide takes up more oxygen from the iron oxide it becomes almost snow white throughout the mass. As the iron oxide is reduced again to ferrous oxide by the lime a portion of it is thrown off from the surface, and when caught in the current of the air and flame is reoxidized, and in the intensity of the light or from absorption of the rays, appears like a black cloud. It quickly subsides, however, to repeat the operation, until, as the mass becomes less and less plastic by the combination of the calcium dioxide and dicalcium silicate, the reaction becomes complete, the ferrous oxide is no longer formed and thrown off, and the mass is finished and ready to be cooled.

Thus is the structure of the Portland cement molecule more and more clearly indicated by a rational co-ordination of the phenomena connected with it.

FRED. W. BROWN.

PORTLAND, COLO., Dec. 17, 1900.

TEMPERATURE STRESSES IN TIMBER-TIE ARCHES OF CONCRETE.

By DANIEL B. LUTEN.

The effect of changes of temperature upon arch structures of whatever material, is to cause the crown of the arch to rise or fall with increasing or decreasing temperature, provided the abutments be fixed and immovable. There results, therefore, a bending moment, greatest at the crown and haunches if the arch is not hinged at those points. It might be supposed then that extremes of temperature in a concrete arch might cause cracking of the arch rib; but it can easily be shown, at least for timber-tie arches of concrete, that such cracking will not occur, even with the most unfavorable assumptions for the material, and for the structure, when subjected to the greatest possible extremes of temperature, provided the proper and usual safeguards be applied in the erection of the arch.

Assuming, for example, the arch of Fig. 1, having a continuous rib of concrete, with light abutments tied together with oak ties beneath the bed of the stream, spaced four feet apart, the whole supported upon a gravel foundation, or upon a single row of piling under each abutment. In order to produce the most unfavorable conditions for temperature stresses, the form of arch is chosen as very low, the rise from the springings being but 4 ft. in a span of 40 ft.

The load of arch ring and earth filling assumed at 100 lbs. per cu. ft. will produce a horizontal thrust at the crown of about 20,000 lbs., for each foot in width of the arch; by drawing the moment polygon for steady load, this thrust will be found to act at a distance of about one inch below the central axis of the arch rib at the crown.

The moving load to which the arch will be assumed to be subjected is taken as a steam road roller weighing fifteen tons. If this entire fifteen tons be concentrated at the middle of the span, and distributed over 6 ft. in width of the arch, it will produce a thrust of 10,000 lbs. at the crown for each foot of width; and this thrust will act at a distance of 9.6 ins. above the central axis. By concentrating the fifteen tons at one quarter of the span, another extreme condition will be produced; the thrust for this arrangement is about 6,000 lbs. acting five inches *below* the central axis.

The first arrangement produces the greater stresses; the thrusts due to dead and live load shown in Fig. 2, have a resultant of 30,000 lbs. acting at a distance of two and one-half inches above the central axis. Assuming the stress in the material to vary uniformly as the distance from the neutral axis, the analysis for the necessary depth of section is made as follows: Let z represent the distance from the central axis to the neutral axis; and let $2x$ represent the thickness of arch ring at the crown; f is to be the maximum allowable stress per sq. in. By taking moments about the center of gravity of the tensile stresses on that section

$$\frac{30{,}000}{12} = \tfrac{2}{3} f \frac{x\,(z+x)}{2.5 + \tfrac{2}{3} + \tfrac{1}{3} z}$$

Also by summation of the forces on the section

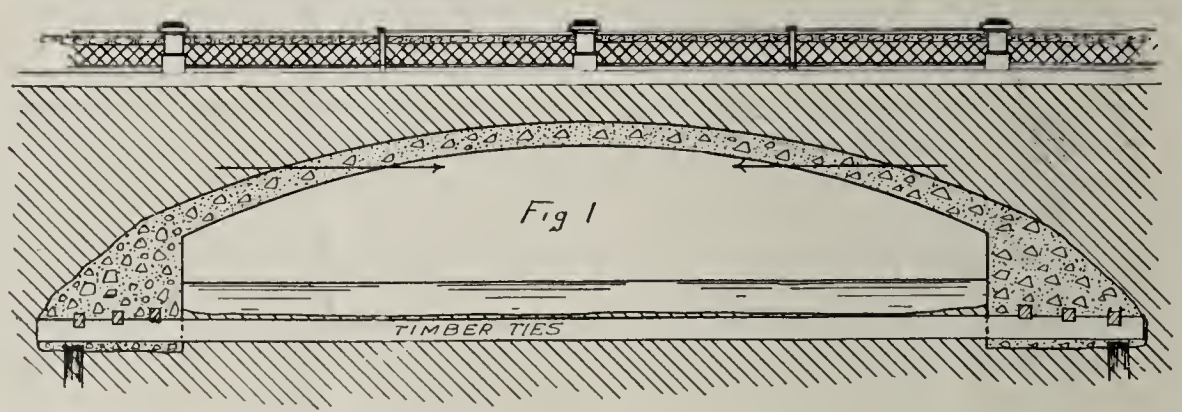
$$\frac{30{,}000}{12} = 2 f \frac{zx}{z+x}$$

The compressive stress commonly accepted as abundantly safe for Portland cement concrete in proportions of 1 : 2 : 4, at seven days, is 300 lbs. per sq. in.; and for tension, 60 lbs. per sq. in. Assuming f to be 300 and solving the above equations, x is found to be approximately eight inches. By proportion from the value of z, f is found to be less than 60 lbs. for tension. For this loading, therefore, the depth of section required for safety under the given loads is sixteen inches.

Similar analyses for other sections show this to be the worst case, and all stresses in the arch due to the given loads, will consequently be less than 60 lbs. for tension, and 300 lbs. for compression, provided the thickness of the arch ring be made proportional to the secant of the angle of inclination, as required for the solution of a parabolic segment. The thickness at the abutments will be eighteen inches.

Assuming the arch erected and the concrete permitted to set at a temperature between 50° and 80° as will usually be the case, we still have to consider the effect of expansion due to a rise of, say, 30°, and contraction due to a fall in temperature of 90° Fahr., giving limits for an arch constructed at 65°; of from 25° below zero to plus 95°.

The effect of expansion may be treated as a horizontal thrust against the abutments. If the abutments of Fig. 1 be assumed free to pivot slightly on the foundations, as will undoubtedly be the case with light abutments held by ties, this thrust, due to expansion, will be resisted by the timber ties, being thus applied at a distance of ninety-six inches below the crown. The amount of this thrust for a parabolic arch hinged at the ends, will be, (Greene's Arches):



$$H = \frac{15}{8} \frac{t\,e\,E\,I}{k^2}$$

in which

t = rise or fall of temperature.
e = co-efficient of expansion.
E = modulus of elasticity.
I = moment of inertia of section at the crown.
k = the rise of the arch.

Applying this formula for expansion, t = 30°; e has been determined by experiments in 1900 by the civil engineering department of Purdue University to range from 0.0000045 to 0.0000050 for one degree Fahr. for 1: 2 : 4 Portland cement concrete. E has been determined by experiments on small specimens to range from 1,400,000 to 3,000,000 lbs. per sq. in. In the Austrian tests on arches of 75-ft. span the deflections of the concrete arch showed by computations that the modulus of elasticity was 1,400,000 lbs. per sq. in. Assuming the more unfavorable conditions, E may be taken as 2,000,000. I is the moment of inertia at the crown for a rib 12 ins. wide and 16 ins. deep and

equals $\frac{1}{12}$ 12·(16)³. And k is the distance of the crown above the line of thrust, equal to 96 ins. Substituting these values in the formula for H, the thrust is found to be 250 lbs. acting, as shown in Fig. 3, at 96 ins. below the central axis. And for a fall in temperature of 90° H is found to be 750 lbs. in the opposite direction, tending to produce compression in the tie. See Fig. 4.

Extreme variations of temperature are of rare occurrence, and it would be only at the rarest intervals that an extreme temperature would occur at the same time that the worst case of loading was on the arch. If, therefore, we assume the worst possible conditions of load and temperature we would be justified in allowing higher safe stresses per sq. in. in the concrete than those assumed for moving and steady loads. Just as steel, when used in bridges for main members is proportioned on a basis, say, of 10,000 lbs. per sq. in., while for members subjected to wind stresses only an allowable stress of 17,000 lbs. per sq. in. may be used. Moreover, the concrete arch will usually be built during the summer, and probably will not be subjected to a great range of temperature within several months; concrete increases in strength for years after placing, and although its most rapid gain takes place in the the first five or six days, yet it may double this strength in the next few months. It is therefore abundantly safe to allow stresses as high as 500 lbs. per sq. in. for compression, and 100 lbs. per sq. in. for tension for the analysis of the worst case of loading and temperature combined. This estimate is even conservative as frequent instances of foreign practice show considerably higher assumptions, which have, nevertheless, produced structures abundantly safe.

For a rise of 30° temperature the the section of the arch at the crown must be such as to resist the thrust of 250 lbs. at a distance of 96 ins., as well as the thrusts due to the steady load and the worst case of moving load, which would be with the roller at the quarter span. The three forces of 6,000 lbs., 20,000 lbs. and 250 lbs. acting as shown in Fig. 3, have for their resultant 26,250 lbs. acting at 3 ins. below the axis. Applying the formulæ as in the previous analysis, with x equal to 8 ins., and solving for f the value of f in compression is found to be 290 lbs. per sq. in. and in tension 20 lbs., both of which values are far within the allowed stresses.

For a fall of temperature of 90° the thrust is 750 lbs., acting at 96 ins. Combining with this the thrusts due to steady load and to the worst case of moving load (with the roller at the middle of the span) we have the arrangement of Fig. 4. Ten thousand lbs. at 9.6 ins., 750 at 96 ins. and 20,000 at 1 in. have for their resultant 29,250 lbs. acting at 5 ins. from the axis. The intensity of stress produced by this resultant is 430 lbs. for compression and 118 lbs. for tension. The latter value for tension lies without the safe limit before assumed. Under the unfavorable conditions assumed for this structure, therefore, the arch would become unsafe if loaded at the middle with a 15-ton road roller when the temperature of the arch is as low as 25° below zero.

It may be noted, however, that the stresses produced by the extreme rise of temperature were much lower; if, therefore, the arch could be erected at a lower temperature (by 15°) than 65°, it would be made safe. Also, if concrete be permitted to set dry, it contracts very slightly in setting, while, if kept wet during the setting period it expands slightly. By the application of water, therefore, an initial expansion can be given equivalent to that of ten or fifteen degrees rise of temperature. In short, a judicious use of water in erection, will secure a structure that can be relied upon as safe, even under the most adverse conditions.

If, on the other hand, this arch be treated as an ordinary concrete arch without timber-ties, but, with the arch ring fixed upon heavy rigid abutments, the thrust due to expansion will now act at a point as shown by the arrows of Fig. 1 at two-thirds of the rise above the springings, and equal in amount to

$$H = \frac{45}{4} \frac{t\,e\,E\,I}{k^2}$$

where k now equals 48 ins. For a fall of 90° there results a pull of 18,000 lbs. at 16 ins. from the axis, which combined with the steady and moving load thrusts produces on the section a maximum compression of 800 lbs. per sq. in. and a maximum tension of 700 lbs. per sq. in. both of which values are excessive and would render the arch unsafe.

While the design could be modified, perhaps, so as to make the structure safe, it would probably necessitate the introduction of at least one hinge, an unsightly device, and one that is difficult of satisfactory application. In any case the spandrel walls of concrete arches should be provided with expansion joints over the abutments, since they do not have the same freedom of vertical movement as arch ring.

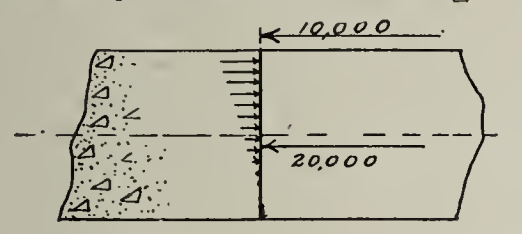


Fig. 2

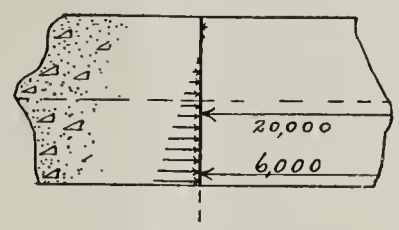


Fig. 3

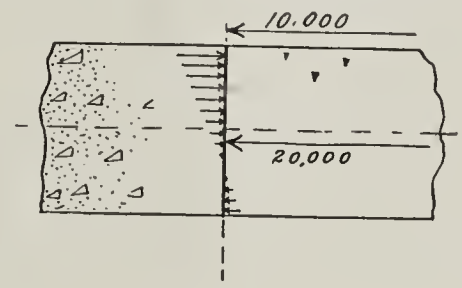
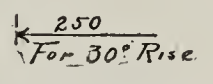
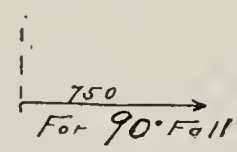


Fig 4





The experiments made at Purdue University to determine the co-efficient of expansion of concrete, show results that are of especial interest, since they prove the fallacy of the oft-quoted statement that the co-efficients for steel and for concrete are practically the same. The experiments gave results for concrete 28.4 per cent lower than for steel. This difference is sufficient to produce a tension in concrete of 125 lbs. per sq. in. for a rise in temperature of 50°, without the addition of any load. It tends to throw some doubt, therefore, upon the safety of concrete and steel combined, unless the steel be proportioned as a reserve to carry the entire stress.

The following specifications are suggested for timber-tie concrete arches:

Plans and Specifications—The work shall be constructed according to these drawings and specifications which shall be considered a part of the contract. In case of discrepancies in the drawings the dimensions as indicated by figures shall be assumed to be correct; and in case of disagreement between the drawings and the specifications, the specifications are to be taken as correct.

DESIGN—The arch ring, spandrel walls, and abutments, shall be so proportioned that in no case shall the stress in the concrete caused by any possible combination of the steady load and the moving load exceed the following intensities:

In compression, 300 lbs. per sq. in.
In tension, 60 lbs. per sq. in.
In shear, 100 lbs. per sq. in.

Except that the allowable stress caused by any possible combination of steady load, moving load, and the extreme range of temperature may be assumed at 50 per cent. in excess of the above stresses. And the arch ring and the abutments and spandrel walls shall be proportioned to resist not only all applied loads, but also a range of temperature of 120° Fahr. The co-efficient of elasticity of the concrete shall be assumed to be 1,500,000 lbs. per sq. in.; and the co-efficient of expansion for one degree Fahr. shall be assumed to be 0.000,005. The timber-ties shall be proportioned to resist the entire horizontal thrust of the arch ring, allowing a stress of 1,500 lbs. per sq. in. for oak or pine and a coefficient of elasticity of 2,000,000 per sq. in.

FOUNDATIONS—The abutments shall be placed on gravel, rock, or pile foundations as indicated on the drawings. Fôr gravel fonndations, the abutments must be so proportioned that the vertical pressure shall not exceed four tons per square foot. Piling for foundations shall be arranged in a single line and shall be driven to a sufficient depth to prevent settlement of the structure.

CONCRETE—The concrete shall be composed of clean gravel, clean, sharp sand, and Portland cement.

GRAVEL—The gravel shall be of sizes such that the greatest dimension of any piece will pass a two-inch ring; it shall be screened and washed free of any clay or other fine material; and shall contain no soft or rotten stone.

CEMENT—The cement shall be a good quality of Portland and shall withstand the following tests: Fineness, at least 99 per cent shall pass a number 50 sieve; 90 per cent shall pass a number 100 sieve; and 75 per per cent shall pass a number 200 sieve. Tensile or transverse tests; the cement shall pass tests satisfactory to the engineer in charge of construction, but neat cement briquettes with 22 per cent of water shall, after seven days, with six days immersed, show a tensile strength of at least 400 lbs. per sq. in., or for the transverse test a modulus of rupture of at least 700 lbs. per sq. in. Cement mixed neat with enough water to form a stiff paste shall after 30 min. at 70° Fahr. be appreciably indented by a $\frac{1}{12}$ in. wire loaded to $\frac{1}{4}$ lb. Pats of cement, neat, on glass plates, shall not crack or scale off when allowed to harden in moist air, or under water or when subjected to moist air at 176° Fahr. for three hours, and then to hot water for two days.

MIXING—The cement and sand shall be mixed dry in proportions such that the cement shall equal at least 125 per cent. by volume of the voids in the sand, previously determined by the amount of water absorbed. The stone shall be thoroughly drenched and mixed with the sand and cement so proportioned that the sand and cement equals at least 140 per cent of the voids in the stone. Sufficient water shall be added to the mixture to bring it to the consistency of damp earth. The whole mass to be thoroughly mixed and to be tamped into place without delay.

FILLING—Spaces between side walls shall be filled with earth, thoroughly flushed or tamped or rolled into place to the required sub-grade to receive pavements and sidewalks.

[TO BE CONTINUED.]

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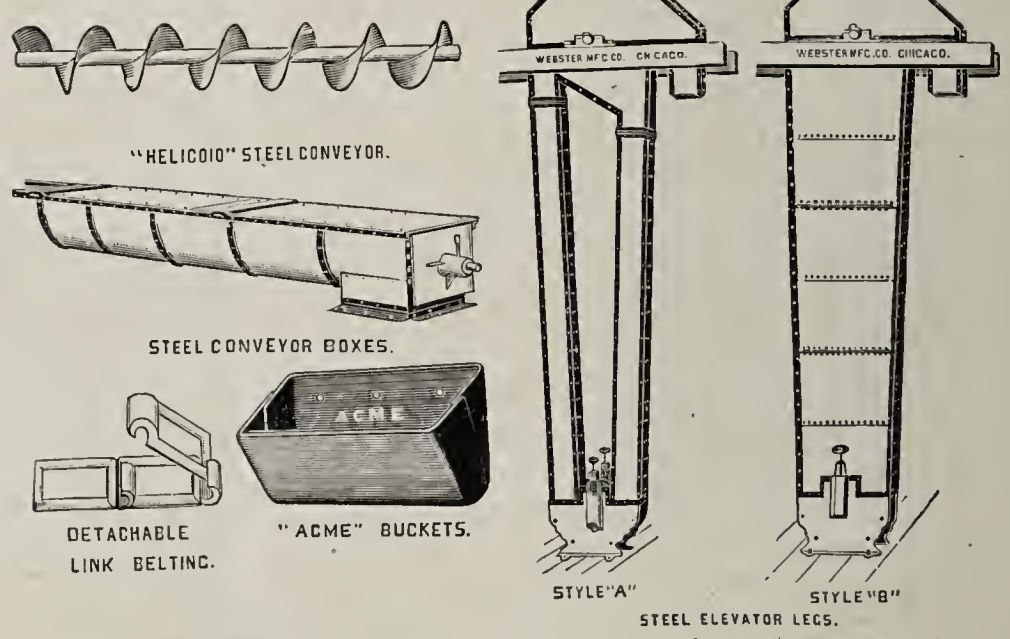

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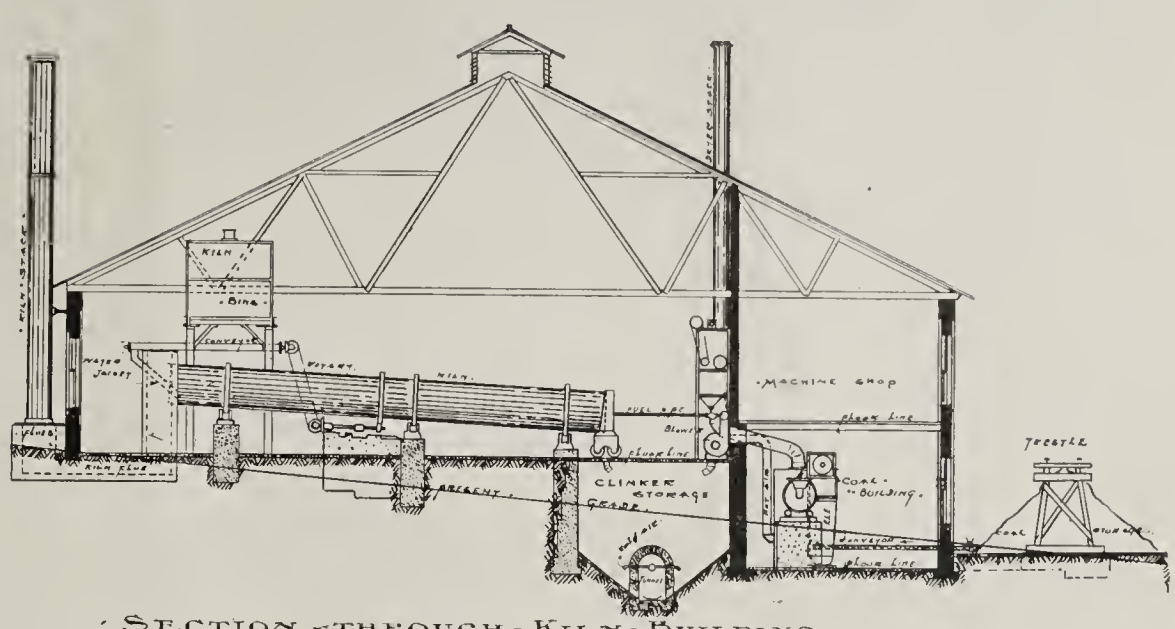

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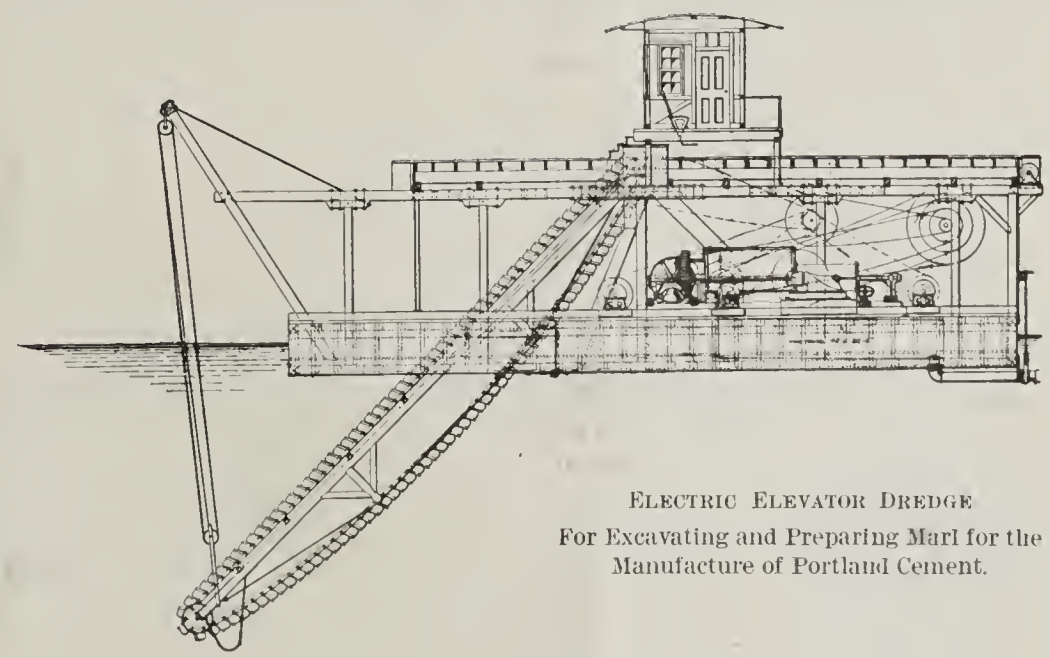

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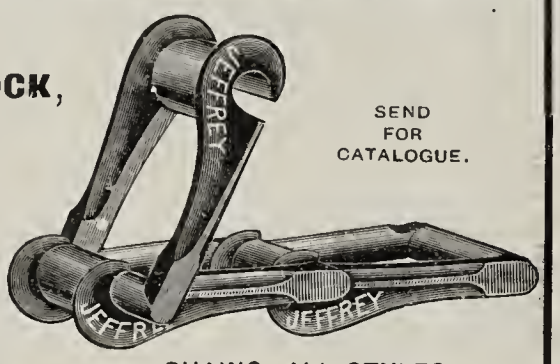

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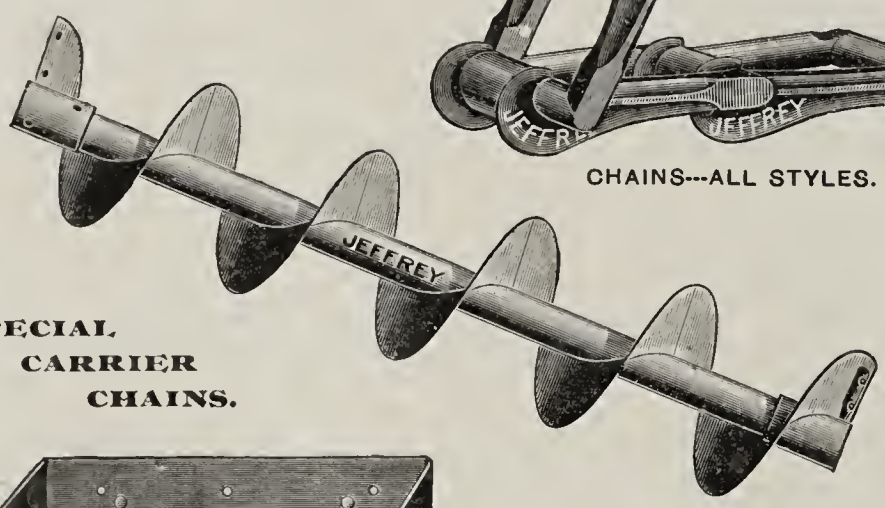

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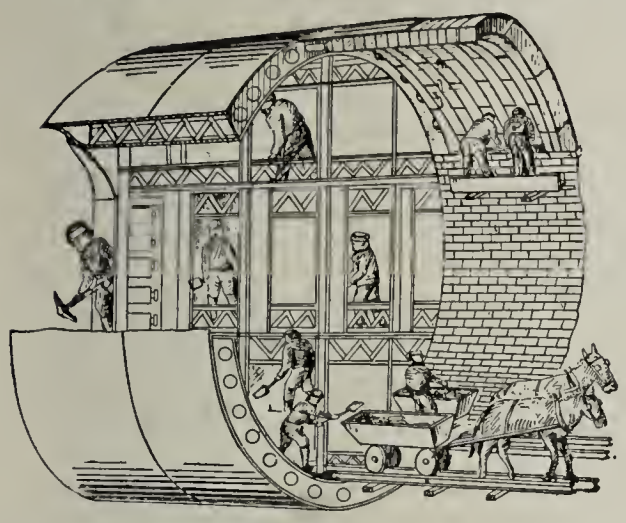

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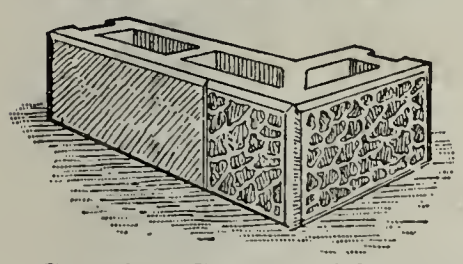

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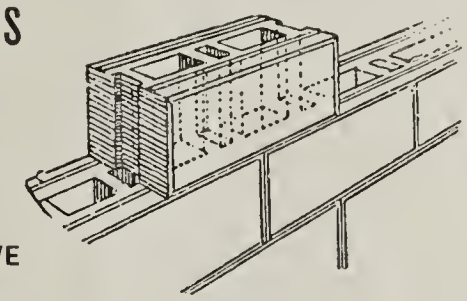

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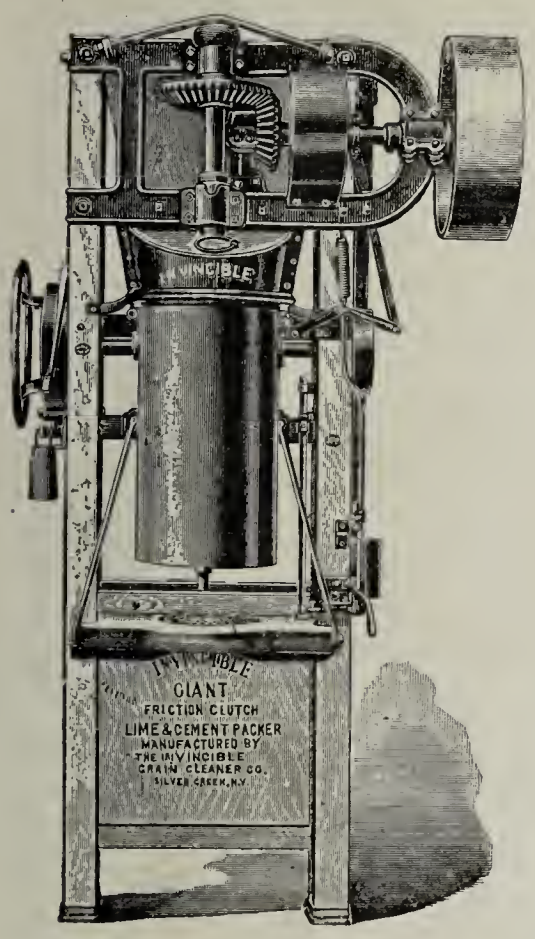

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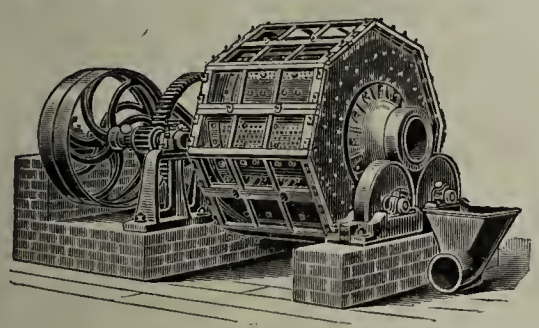

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

CEMENT TRADE FOR 1901.

The outlook for the Portland cement trade during 1901 is good. Work that has been held in abeyance for the past two years on account of the high price of steel and cement, as well as the unsettled condition of the labor situation, will now be carried out. Much new work is likewise in sight which will call for large quantities of Portland cement.

The old and well-known brands will command fair prices, while the new brands coming into the market for the first time will encounter a backward market under the strong competition and abundant supply of the old brands that are now holding the confidence of the consumer. The new brands will be compelled to make low figures and give strong guarantees that the resultant work into which their cement enters will prove sound under all circumstances. It takes time to inspire confidence in new and untried brands; therefore, the consumer hesitates before he is willing to adopt something new. The same conditions obtained when the foreign Portland brands had the right of way in the United States; then there was a deep-seated prejudice against all brands of American Portland cements. The consumer willingly paid much higher prices for the European brands, and thus millions of dollars were freely sacrificed to feed this prejudice which existed against American Portland cement. This simply shows the value of an established trade mark; it requires time and money to build it up and when once established it cannot be overthrown in a day.

CRUSHED STONE.

The rapid increase in the use of Portland cement throughout the country is building up the crushed stone industry, which is now far behind the legitimate demand. There should be crushed stone plants in the neighborhood of every town of 3,000 population in the country, especially on the line of railways who use vast quantities of this material. It would likewise further the interest of the local authorities by giving material for the construction of macadam roads and village streets, especially where gravel is scarce.

The use of crushed stone in concrete for sidewalks and masonry is more economical than sand alone, since the proportions call for less cement in the mixture. Cement sidewalk contractors would, likewise, become good customers. The large cities are usually well supplied with crushed stone plants. The opportunities in the smaller cities should be looked into and plants established, as remunerative returns, under fair management, can be assured on the capital invested.

UNITED STATES COAL IN EUROPE.

Less than a year ago, when the possibilities of American coal competing with the English product were being considered, the matter was generally ridiculed by the English operator. Now that our coal is actually coming into competition with that of England, the British press is reluctantly admitting the virtues of the American product, as will be seen from the following, taken from a recent issue of the London Telegraph:

"Basing their calculations on the tests so far made in American gas coal, the South Metropolitan Gas Company obtain results which justify the recent purchase they made of some 4,000 tons of this mineral for experimental purposes. The cost of Durham coal, which is the best English coal obtainable for gas-making purposes, is at the present time about 16s. ($3.89) per ton, free on board, and the freight to London is 4s. (97 cents) per ton, giving in round figures a total cost of 20s. ($4.87) per ton. The American article, including freight, touches about 27s. ($6.57) a ton. There is therefore a considerable margin in favor of British coal on the score of prime cost, and any counterbalancing advantage gained from the use of imported coal must lie in its better producing qualities and its superior yield of coke and other marketable residuals. Roughly speaking, a ton of Durham coal will produce from 10,000 to 10,500 cu. ft. of gas. The American contractors hinted at between 14,000 and 15,000 cu. ft. per ton as the yield of their supply, but although the results show figures considerably exceeding those attaching to British coal, they fall much short of the American estimate. It is necessary, however, to note that experiment has so far been made with only a fraction of the 4,000 tons brought over, and fuller tests may materially affect the companies one way or the other. Nor can the tests be regarded as thoroughly satisfactory in that the American article has had a slight admixture of the British. In future experiments, this combination will be avoided and the imported coal taken on its merits entirely. On the whole, the test has proved more favorable than a similar one recently made in Paris."

I was shown a letter from a leading Cardiff exporter, in which the statement was made that there would be further advances in the price of Welsh coals in consequence of the strike in the anthracite mines in the United States. Such an excuse for further advances in the price of English and Welsh coals is not sufficient, from the fact that there is so far but a small tonnage of American coal coming here, and no anthracite at all. The facts are, the English operators think our coal will cease to be a competitor in this market during the American strike, and, having nothing to fear from the outside, they will advance the price of coal for speculative purposes.

NANTES. JOSEPH I. BRITTAIN,
U. S. Consul.

The 20th Century Portland Cement company has been organized at Fenton, Mich.

The Birmingham Cement company of Ensley, Ala., has nearly all of its new machinery on the ground.

THE ARMOUR INSTITUTE OF TECHNOLOGY.

Technological education, as it is carried out in this country to-day, is a product of the last quarter of a century. Before 1875 only a few schools pretended to give an engineering education. The first legislation which gave a decided impetus to this form of education for the American youth was the Morrill Land Grant Act of 1862. This act granted public land to the several states, apportioning 30,000 acres for each senator and representative, to be devoted solely to the advancement of instruction in the agricultural and mechanic arts. The full effect of this act was not felt until after the beginning of the last quarter of this century, when there was established in almost every state a school to carry out the purpose of the act. From that time on the growth of technological education was phenomenal, whether we consider the actual outlay upon material equipment, the increased number of students, the constantly improved methods of instruction, or the continued elevation of the standard of instruction. In addition to the governmental aid rendered, many private citizens subscribed liberally to the needs of institutions already established, or made large endowments for new ones. This great advance came from a general acceptance of the view that industry needed the aid and assistance which comes from technical training. With the introduction of new machinery, with the enormous increase of inventions, with sharp competition on a constantly narrowing margin of profit, it became evident that more refined and scientific methods were needed even in ordinary business matters. It was recognized that the so-called engineers of former times were merely great constructors, wasteful of both power and material. With this change of industrial demands came the needed supply in the form of young men, trained, not in the classic halls of some favored university, but in the workshops and laboratories of institutes of technology. These men were educated to understand the fundamental principles of science, not merely in their broad general aspect, but in every matter of practice, detail and application. They supplied the need of modern methods of industry.

It is not surprising, then, to find that so far-sighted a business man as the late Philip D. Armour recognized both the needs of modern industry and the capacities of young men when, in 1892, he founded the Armour Institute of Technology. His primary object in founding some educational institution was to enable young men to improve their station in life. Looking at the matter from the point of view of a man of affairs, he readily saw that the greatest amount of good would result by training young men in accordance with the demands of modern civilization, rather than according to the ideals of the older classical mold. This work to be successful, he saw, must be along the lines of applied science. To carry out his ideas he secured the aid of Rev. Dr. Frank W. Gunsaulus. While neither was a distinctly technical man, yet both were broad minded enough to recognize the problem in its entirety and to adopt business methods for its solution. They saw that the forerunner of modern civilization is no longer the woodman with his axe or the farmer with his plow, but the trained expert engineer who builds bridges, lays out railroads and develops the natural resources of a new country for the service of mankind. Since the engineer is the man of applied science, engineering courses were organized. Those first established were mechanical and electrical engineering. To these were added, later, courses in architecture, civil and chemical engineering. To give a home to all this work, Mr. Armour erected a five-story, fireproof building, which, with the total equipment, cost about $500,000. The work in mechanical engineering covers complete courses in drawing, kinematics of machinery, mechanics of engineering, steam engineering, shop design, heating and ventilation, mechanical laboratory practice, experimental engineering and shop work. The laboratory equipment for this work is complete, giving every facility for students to become familiar with the best modern practice of mechanical engineers. The course in electrical engineering covers electricity and magnetism, direct current dynamos, arc and incandescent lamps, primary and secondary batteries, alternating currents, central station design and electric railways. The equipment of this department is complete, the apparatus being of the highest grade of excellence and ample in scope.

In answer to repeated demands made upon the institute a department of commercial tests has recently been formed. The splendid equipment of the institute offers unusual facilities for the testing of boiler and engine plants, pumping stations, dynamos, motors and materials of construction; for the calibration of pressure gauges and electrical instruments; for chemical analysis of engineering materials and for special tests and investigations.

The estimate in which Armour Institute of Technology is held may be gathered from a recent report of the British vice-consul, Thomas Erskine. Mr. Erskine was required by the British government to make a report upon education in Chicago. In this report he devoted 16 pages to the work of the institute, giving a detailed statement of its equipment and of its courses of study. This report has been widely circulated in Great Britain, and the work of the institute has been favorably commented upon by the London *Financial Times*. In this report to the British government Vice-Consul Erskine quoted from an address made by Dean Victor C. Alderson before the Central Railway Club in Buffalo in March, 1900, on the "Economic Aspect of Technical Education," as follows:

"The continued growth and prosperity of any nation depends upon the technical education of its people. The man who does most toward increasing the general material prosperity of a country, who calls to the aid of mankind all the forces of nature, is the man of applied science, usually called an engineer. The war in South Africa or the Philippines is less fatal to the working man than the ceaseless competition of similar working men in other quarters of the globe. It is this unremitting rivalry between workers of the same class the world over that makes necessary the cultivation of the working man's powers by means of technical training. I believe that the most important element in giving one nation industrial supremacy over another is the technical education of its people. Foreign agents, consular reports, natural inventive ability, keen business sense, all aid, but they are individually and collectively inferior to the power that comes from having the workman, the superintendent, and the manager, all carefully trained to do his moiety in a superior manner. Inasmuch as England is without a general public school system, as we know it, her system of technical training is unorganized, uncoordinated, and very largely what we call trade school instruction. Furthermore, it has, as its persistent enemy, that English bugbear, the practical man, without a trace of theory in his composition, who blocks the advance of technical training in every way he can. We should not rest satisfied with the inventive genius of a Fuller, a Whitney, or an Edison, but should recognize that permanent industrial success will only come when every workman, foreman, and superintendent is trained to the highest degree of efficiency. Our best institutes of technology should train men as well for the profession of engineering as they are trained in Germany or in Switzerland."

One feature of the work of Armour

Institute of Technology which was ably supported by Mr. Armour and President Gunsaulus came from their deep interest in the welfare of the students. The history of each graduate is carefully preserved and every effort is made to secure positions for them. Not only are students assisted in securing places immediately after graduation, but they are aided for years afterward to gain more lucrative and responsible positions. At the completion of either of the courses in engineering the degree of bachelor of science is conferred. In order to receive the professional degree of mechanical engineer, electrical engineer or civil engineer, the graduate may qualify himself in either of the three following ways:

(a) Pursue post-graduate study for one year at the institute, and engage for at least two years in successful engineering practice or teaching, of which at least one shall involve responsibility.

(b) Submit a thesis after at least three years of successful engineering practice or teaching, of which two shall involve responsibility.

(c) The graduate may engage in successful engineering practice for at least four years, of which three shall involve responsibility.

The law does not recognize engineering as a profession, consequently, the professional standing of engineers must be maintained by the profession itself. This method of conferring the engineering degree is in harmony with the best thought and experience of mature engineers the country over. In order to be an engineer, worthy of the title, a young man should not only complete the regular technical training in college, but should also show natural adaptability to the work, and should have experience. All these elements are considered before the full engineering degree is conferred.

The work of Armour Institute of Technology, however, is not merely technical. It endeavors to train its students first to be men, with all the responsibilities that go with citizenship and a high standard of character. After this it endeavors to train them to be high grade engineers. To bring about this ideal condition there is required in each one of the courses a regular amount of work which may be deemed cultural, embodying courses in English, history, economics, logic and psychology. In planning the engineering courses one central point has been kept in mind, namely, the demand of the present day is not so much for men specialized in either mechanical, electrical or civil engineering lines as it is for men who are well grounded in the essentials of engineering practice. With this end in view, the mechanical engineering course includes work from the civil and electrical engineering; the electrical engineering course contains mechanical and civil engineering; while the civil engineering course covers, besides the strictly civil engineering work, short courses in both mechanical and electrical engineering. A young man who takes either one of these engineering courses becomes well grounded in general engineering practice and is capable of making himself serviceable in many lines of industrial activity.

MAILED ON APPLICATION—"Hand-Book of Useful Information for Cement Users." Compiled by E. Duryee, C. E., Portland Cement Specialist, Colton, Cal.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

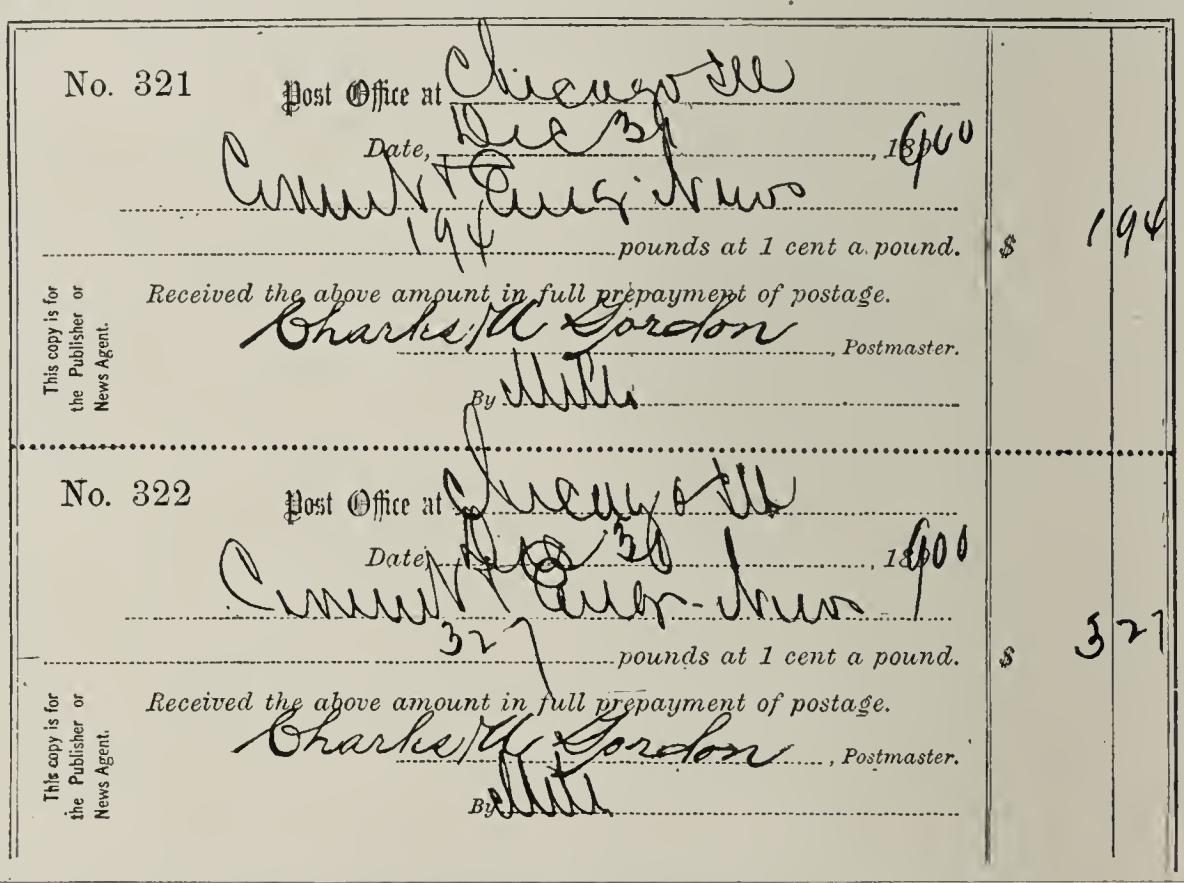
"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

A company has been projected to manufacture Portland cement at Bay City, Mich. Julius Stroh is interested. The marl deposit is located at West Branch, near Bay City.

OUR CIRCULATION.

As shown by copies mailed at pound rates on December 31, 1900, 521 lbs., 8 copies to the pound, making 4,168 copies entering the mail for points outside of Chicago. We circulate besides within the city of Chicago by carrier and stamp, 495 copies, besides our foreign list of 340 copies, giving the CEMENT AND ENGINEERING NEWS 5,003. Following is a fac-simile of receipt:


No. 321 Post Office at Chicago Ill
Date, Dec 31, 1900
Cement & Engineering News
194 pounds at 1 cent a pound. $ 1 94
This copy is for the Publisher or News Agent.
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Charles M Gordon, Postmaster.
By

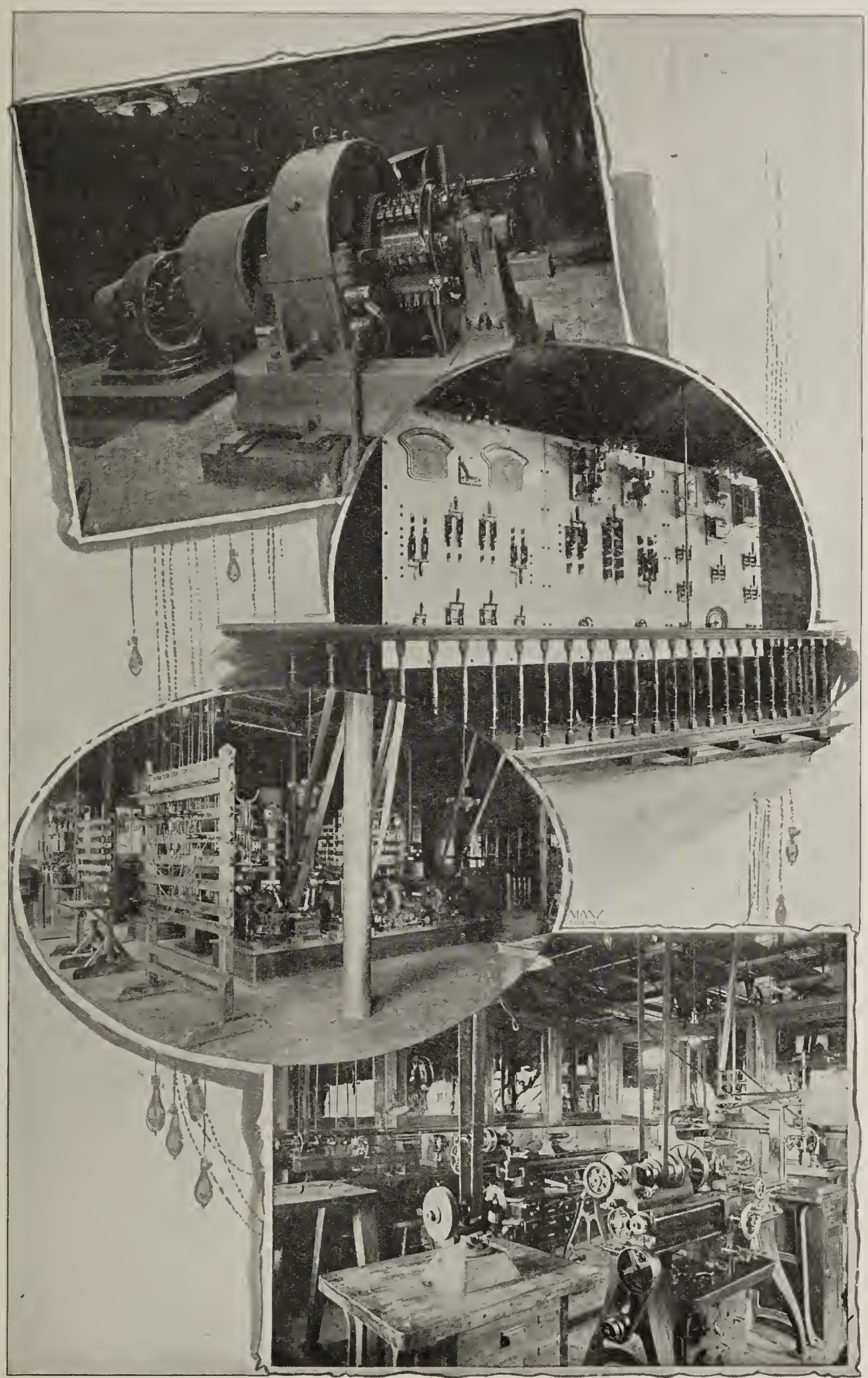
No. 322 Post Office at Chicago Ill
Date, Dec 31, 1900
Cement & Engineering News
327 pounds at 1 cent a pound. $ 3 27
This copy is for the Publisher or News Agent.
Received the above amount in full prepayment of postage.
Charles M Gordon, Postmaster.
By

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	NOVEMBER. 1899. QUANTITY IN LBS.	NOVEMBER. 1899. VALUE IN DOLLARS.	NOVEMBER. 1900. QUANTITY IN LBS.	NOVEMBER. 1900. VALUE IN DOLLARS.	ELEVEN MONTHS ENDING NOVEMBER. 1899. QUANTITY IN LBS.	ELEVEN MONTHS ENDING NOVEMBER. 1899. VALUE IN DOLLARS.	ELEVEN MONTHS ENDING NOVEMBER. 1900. QUANTITY IN LBS.	ELEVEN MONTHS ENDING NOVEMBER. 1900. VALUE IN DOLLARS.
United Kingdom....	16,042,700	65,395	18,628,182	71,434	76,844,256	297,663	104,889,729	408,013
Belgium..	30.465,241	95,394	23,013,464	69,184	233,581,529	693,809	288,173,307	865,262
France	595,200	2,399	892,800	3,860	6,253,045	22,230	12,605,888	45,740
Germany.....	51,784,742	186,900	27,173,718	96,518	437,107,527	1,546,657	432,108,226	1,611,523
All Other Europe ...	4,458,570	13,871	2,400	9	25,465,863	68,692	28,761,217	87,753
British North Am...	111,350	633	29,450	186	1,715,440	8,668	1,803,986	9,383
Other Countries.....	5,900	20	.....	.....	815,500	4,013	9,547,680	41,415
TOTAL	103,463,703	364,612	69,740,014	241,191	782,783,160	2,641,792	877,890,033	3,069,089
Domestic Exports of Cements, bbls.	3,479	7,871	18,323	43,346	73,180	151,061	82,629	185,743

There were 1,922,675 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on November 30, 1899, valued at $6,258, against 16,597,111 lbs., valued at $55,808 in November, 1900.

Imports of asphaltum or bitumen for November, 1899, were 6,216 tons valued at $25,575; November, 1900—11,085 tons valued at $46,337. For eleven months ending November, 1899, 91,814 tons valued at $289,902; for eleven months ending November, 1900—105,881 tons valued at $380,020.



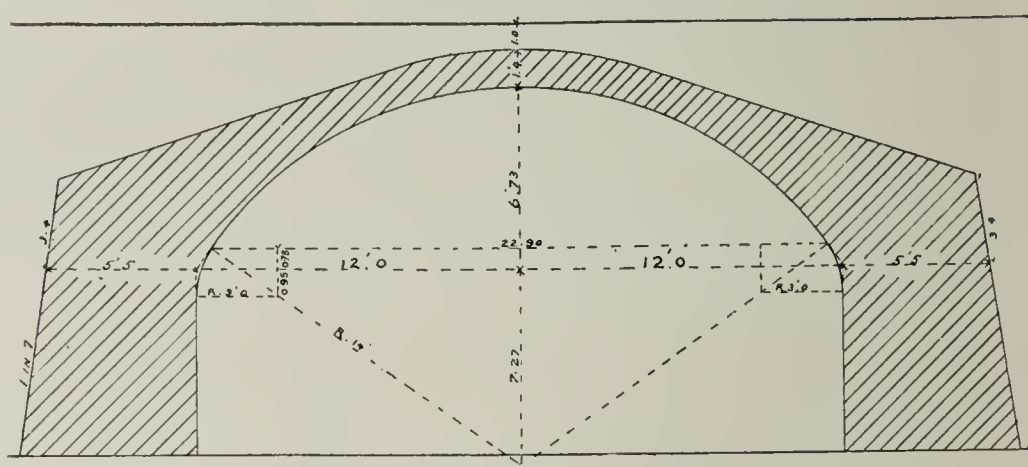
ARMOUR INSTITUTE OF TECHNOLOGY.

Showing dynamo, switch-board and incandescent lamp testing rack, forming part of its laboratory equipment, with machine shop in lower right hand corner.

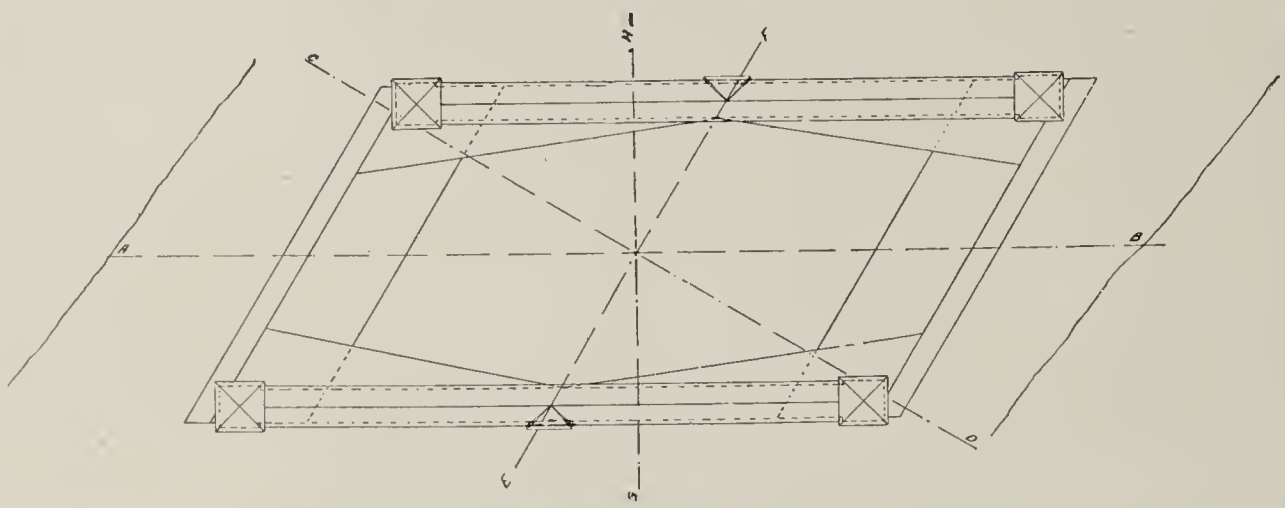
CONCRETE SKEW ARCH BRIDGE.

The sanitary district of Chicago has just completed a concrete skew arch bridge over the tail race regulating works at Lockport, Ill. The bridge has a span of 24 ft. and contains 262 cu. yds. of Portland cement concrete which was put in place at $11.75 per cu. yd., including cost of forms. The concrete was mixed 1 part Portland cement, 2 of sand and 5 of crushed stone. Our illustrations show the plan, section of the arch through C. D., section E. F. projecting on line C. H., together with a half tone plate of the completed bridge in place.

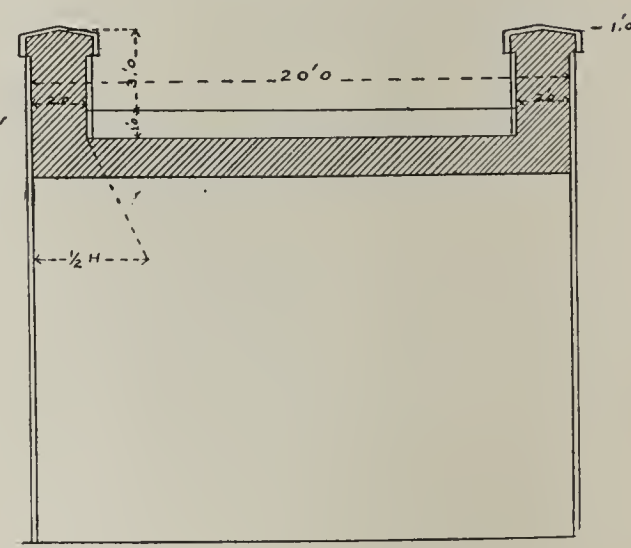
SKEW-ARCH BRIDGE.—SANITARY DISTRICT OF CHICAGO.



SECTION C.-D.



PLAN.



SEC. E.-F. Projected on line G.-H.

The California Portland Cement Co., of Colton, Cal., has published a pamphlet illustrating and describing its plant, materials, use and method of manufacture, together with many suggestions for the use of Portland cement, under the following headings: Cement for buildings; materials for concrete; laying cement walks; data for concrete; estimate of quantities; cement and sand required for one cubic yard of mortar; measure of water; general estimates of quantities. Mailed on request to those interested.

NEW QUARRIES TO BE OPENED.

The American Quarries Company, a new company, is preparing to open up the Fishing Creek district in the southeastern part of Lawrence county, Ind. The company is a branch of the Cleveland Stone company of Ohio. It is the intention of the new company to immediately expend $200,000 in opening up stone on 1,800 acres of land which it recently bought, and to establish a plant with the most improved machinery. One of the main features will be a twenty-gang stone sawmill, including planers and diamond saws and electric travelers. A. T. Smith, formerly superintendent of the Consolidated Company, will superintend the new company's works.

The Buckeye Portland Cement Co. will install additional machinery.

A 600-bbl. Portland cement plant is under consideration at Greentown, Ohio.

V. O. Foulk of Cleveland, O., formerly connected with the marl deposit at Milford, Ind., has now located an oolitic limestone deposit near Marengo, Crawford county, Ind., with the view of promoting a Portland cement plant at that point.

The officers of the Consolidated Cement Co., of Milwaukee, Wis., were elected January 16. Those chosen were as follows: President, Charles L. Kiewert; vice-president, Max Landauer; secretary, A. E. Smith; treasurer, Henry Herman; directors, Oliver C. Fuller, F. C. Eschweiler and P. H. Reilly. A $75,000 building is being erected by the company on a 70-acre tract near Whitefish Bay, where the works are located.

C. Hooke, city engineer of Chattanooga, Tenn., has invented an asphalt furnace and heater for street work and is now ready to place the same on the market.

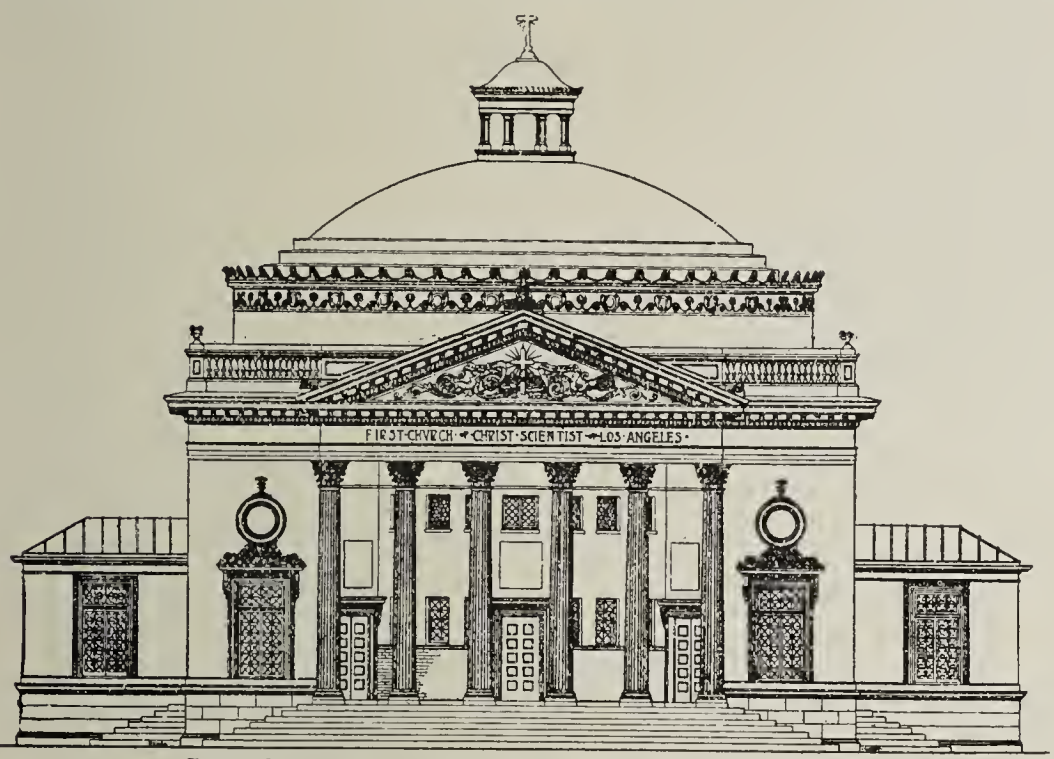
We clip the following from the Boston *Herald* of January 11: The Portland Cement Co. has filed a certificate increasing its capital stock from $1,500,000 to $5,000,000.

The Pyramid Portland Cement Co. of Detroit, Mich., has been organized. Capital, $500,000; A. E. F. White, president. This company owns 340 acres of marl lands at Spring Arbor, Jackson county, Mich. Incorporation papers were filed January 1st, 1901. The design is to erect one-half the plant for the present, installing eight rotaries, to be increased in the future to meet the demands of the market.

A CONCRETE FINISHED EDIFICE.

One of the most unique church edifices that has been designed for some time is the one now under construction at Los Angeles, Cal., for the First Church of Christ (Scientist). The design is of the Greek Corinthian order, the society having adopted the classical forms for all their buildings throughout the country. The exterior walls will be brick, with cement plaster finish, and richly ornamented in stereo relief. The main roof, being in the form of a large dome, will be covered with a composition roof. The principal entrance, which encloses the portico, is in the form of a hexastyle, with columns running to the full height of the building. From each side of the portico extend lobbies leading to the main auditorium and the galleries. The main auditorium is nearly circular in form, and terminates above in a large dome, which is supported by four arches in such a manner as to give an unobstructed view of the speaker from all points of the auditorium; the floor sloping to a central point. The principal sunday school room is located between the main entrance and the auditorium, and is connected by sliding partitions. There are also on the main floor the readers' room and directors' meeting room. The interior woodwork will be in white enamel and ornamented in gold leaf. The walls and interior of the large dome will be handsomely frescoed. The organ loft is located in the gallery at the rear of the building. Surmounting the main dome is a smaller dome in which is contained a fine chime of bells, operated by electricity. The basement will contain additional sunday school room, toilet rooms, and quarters for the steam heating and ventilating appliances. The lighting of the building will be accomplished by means of discs of ground glass which are set in the walls at various points. In the interior of the main dome will be a "sunburst," formed of ornamental metal work and prismatic glass; the sunlight being brought to this point and diffused by means of Luxfer prisms and mirrors from above, which at night is illuminated by about 150 incandescent lights, and so arranged that the entire building is at all times flooded by a soft, subdued light. Art glass windows will be employed in the main walls.

The main contract has been let to Frank L. Spaulding; the painting to Wing & Arenz, and plumbing to F. J. Harrison.



First Church of Christ (Scientist), Los Angeles, Cal.

TEMPERATURE STRESSES IN TIMBER-TIE ARCHES OF CONCRETE.

By Daniel B. Luten.

(*Continued from page 92, December, 1900, issue.*)

Placing—All concrete used in the arch rib, which is to be assumed as extending through the abutments to meet the ties, shall be of the same proportions and shall be mixed under the same conditions, as nearly as possible. Concrete placed under water for the abutments shall be deposited by chute, or by drop-bottom bucket, to prevent washing out of the cement. The concrete shall be laid countinuously, working day and night if necessary; no break in the continuity of the arch rib shall be permitted. In case it becomes impracticable to place all of the concrete at once, the division must be made parallel to the arch face, so as to divide the arch into ribs; and each succeeding rib must be thoroughly cemented to its neighbor by cleaning, roughening, and washing with a liquid mortar of one cement to one sand.

Facing—All concrete facing shall be composed of one part Portland cement to two parts sand and shall have a depth of at least one inch on all exposed faces. It shall be tamped into place with the concrete backing to form a solid whole.

Timber-Ties—The timber-ties shall be of clear, green, oak timber, and shall be immersed in water at least twenty-four hours previous to embedding in the concrete. If it becomes necessary to use seasoned timber, it shall be immersed for at least three days previous to the placing of the concrete. The ties shall be thoroughly bedded and covered in the bed of the stream. If built-up ties are used, the timbers shall be at least three in number and shall be spliced with joints lapping at least six feet and fastened with scarf plates and wooden pegs to develop the full tensile strength of the net section. The ties shall be embedded in the concrete of the abutments, being held by interlocking cross-timbers, and by notches cut in the ties, as shown in detail on the drawings. Especial care must be taken to tamp the concrete thoroughly around the timbers and into the notches.

False Work—Rigid centering and forms shall be provided to receive the concrete and to hold it in place until firmly set. The timber-ties shall oonstitute the tension chord of this system of false-work. The forms shall be made non-absorbent by painting or other suitable water-proofing. The centering shall not be removed from the structure until at least thirty days after the completion of the arch ring.

Sprinkling—The concrete shall be kept thoroughly wet by constant sprinkling day and night for at least three days after initial settling.

Iron Railings—Iron hand railings, if used, shall be painted with two coats of mineral paint after erection.

Erection—All materials, tools, appliances. and machinery, and suitable labor necessary to the erection of this structure according to these plans and specifications shall be provided by the contractor. He shall also assume all risks of loss by flood, or other causes, during the erection and will provide danger signals, and watchmen to guard the structure up to the time of its completion.

Cleaning Up—The contractor shall remove all false-work and all surplus material from the street.

Travel—The structure shall be thrown open to traffic seven days after the completion of the arch rib.

Inspection—All materials shall be subject to inspection and approval according to these specifications.

Interpretation — The purchaser of the structure or his engineer shall control as to the interpretation of his drawings and specifications; but the contractor shall have the right to obtain redress for unjust decisions.

[THE END.]

JACKSON'S CONCRETE AND STEEL FLOOR, SIDEWALK AND ROOF CONSTRUCTION.

We illustrate Peter H. Jackson's patent floor, sidewalk and roof construction, which consists of webs formed of sheet metal, punched so as to form openings, with burs or walls projecting approximately at right angles with the surface of the sheet, the ribs between the openings forming practically straight and continuous linear bars to resist tensile and other strains, and in combination therewith of a coating of plaster material, preferably Portland, in which the punched sheet metal is embedded.

Fig. 1.

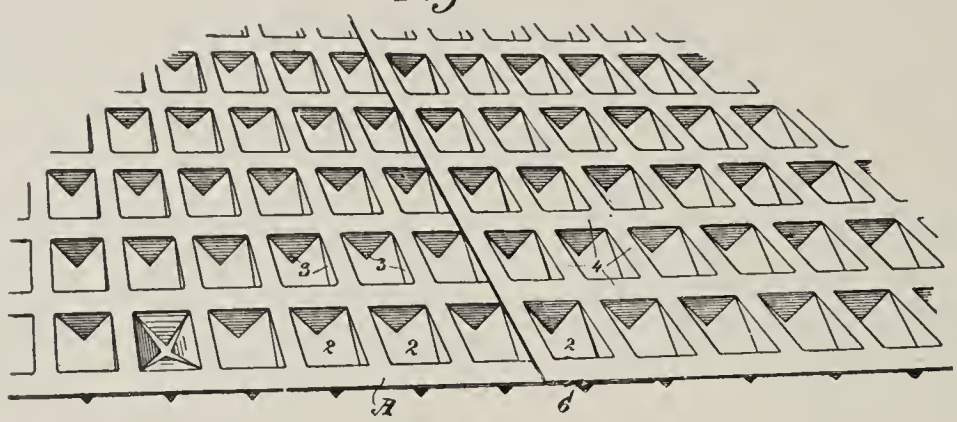


Fig. 2.

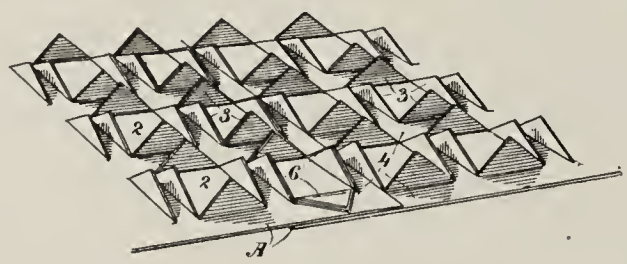


Fig. 1 is a view of a section of a plate showing one arrangement of the openings and burs. Fig. 2 is a view of the opposite side, showing contiguous sheets overlapping and the burs interlocked.

The patent claims are as follows: The combination in a floor, roof, wall, or like structure which is subjected to weight or pressure from one side, of cement or concrete forming the body, and plates of flat sheet metal embedded therein, farthest from the surface from which the pressure is exerted, said plates having rectangular openings in the direct line of strain, and said openings being filled with pillars of concrete forming continuations of the bodies upon opposite sides of the plate, and upturned metal flanges surrounding and inclosing the concrete pillars.

The combination in a floor, roof, wall, or like structure which is subjected to weight or pressure from one side, of cement or concrete forming the body, and plates of flat sheet metal embedded therein in planes within that portion which is subjected to tensile strain, said plates having rectangular openings, two sides of which are at right angles with the lines of strain, and through which the body of concrete or like material above and below the plates is united, said openings having vertical upturned walls surrounding and enclosing the concrete pillars which extend through them.

Mr. Peter H. Jackson of 228 First street, San Francisco, Cal., will be pleased to answer all inquiries relating to this system of construction.

The Wayland Portland Cement Co. of New Jersey has been incorporated. Capital, $800,000.

THE AMERICAN ISTHMIAN CANAL.

Congress, at its last session, passed an act looking in this direction, authorizing the appointment of a commission to examine all possible routes with a view of selecting only the best, and appropriating a million of dollars for the purpose. And now that commission has done its work, the larger body of it, last summer, made an exhaustive study of the ship canals of Europe and especially of the present state and condition of the Panama company. They examined and considered locks, but not tunnels. They made a re-survey and reconnaisance of the Nicaragua route and, according to newspaper reports, found such serious faults in the plans formerly considered settled, as to fully show the importance of proceeding slowly and carefully in matters of such importance. They also made a physical examination of the Panama canal. Meanwhile, a smaller body of the commission, or its employes, was sent to examine the Darien region, and especially those short sea-level routes, the Caledonia Bay and the San Blas, which have every advantage and but a single objection—that of a tunnel being required. The commission has made its preliminary report, which has been submitted to congress by the president. In it, on page 8, they state with sufficient clearness the object of their appointment. They say: "The purpose of the investigation, undertaken in compliance with the law under which the commission is acting, was to determine the most feasible and practicable route across the American isthmus for a maritime canal between the Atlantic and Pacific oceans, together with the cost of constructing the same and placing it under the control, management and ownership of the United States."

The pre-conceived views of the commission in regard to the important points are well indicated in their creation of the various committees on, to-wit: The Nicaragua route, the Panama route, all other possible routes.

The main body of the commission and the largest measure of time was given to the first mentioned route, the Nicaragua, which, without any extended discussion of its difficulties or statement of objections, was pronounced feasible and favored beyond all other routes. Certainly a sufficiency of time and attention was also given to the second subject, the Panama route, and its difficulties and the objections more fully stated. But the third subject "Other Possible Routes" received scant courtesy even. They say: "The ridge was traced continuously on the ground from the head of the river Carti, a little east of Mandinga harbor in San Blas bay to the head waters of the Chagres, and thence down the river to the Panama railroad, a distance of 24½ miles; also near Caledonia bay from the Carreto summit to the Sassardi summit, a distance of 27½ miles. The lowest elevation in the former section was 956 ft., in the latter 683 ft. Between these two sections, from San Blas bay to Caledonia bay, a distance of 81 miles, in an air line; and from Caledonia bay southward to the Atrato river the examination was made from the sea," that is, they sailed along and looked for depressions in the mountain ranges, certainly a sufficiently easy and superficial method of determining the feasibility and practicability of all other possible routes. In their conclusions they are equally brief, they give the San Blas seven lines, saying: "The San Blas route extends from the bay of that name to the mouth of the Bayamo on the Pacific; it has been advocated as the shortest line between the two oceans, which is

true. The most complete plan developed involves a tunnel at least 7 miles long. While not necessarily impracticable, such a tunnel would be very objectionable and would render the line inferior either to the Panama or the Nicaragua location." The commission does not say why or how a tunnel would be objectional, while the statement that its existence would render the line inferior to the Panama or Nicaragua is clearly the barest of bare assertions.

In the days of Commander Selfridge the cost of the tunnel was the matter that put this short sea level route out of the question. Under modern methods it would cost comparatively little and would now easily come within the engineering axiom that "a tunnel through a hill becomes necessary or advisable whenever it will cost less to remove so much of the material as will permit a safe passage, although at a greater expense for like quantities than to make an excavation open at the top." On the Sassardi, one of the three Caledonia bay routes, the required tunnel would be only $1\frac{6}{10}$ miles in length, which could be made an open cut if that is a sine-qua-non at far less expense than the long routes with locks and uncontrollable rivers among their objections. The commission have no words to expend upon the immense advantages of these short routes as compared with two long ones with locks. First, and above all, that they are sea-level routes. There can be no question whatever as to what is the best kind of a ship canal. It is a sea-level canal. If such a canal be possible, none other should be considered. It is equally clear that the best route, other things being equal, is the shortest route. Again, any canal built by a government should be as free as possible from annual expenditures for maintenance and repairs. The short sea-level routes fit this condition perfectly. With only tide-gates or, perhaps, a tide-lock to attend, they have perfect harbors at both ends, that having been formed by nature will remain natural harbors without expense. In time of transit, seven hours, or less, by the sea-level routes against 15 to 45 hours by the longer routes. Entire escape of the danger zone, of summit level and water supply, all dangers from rivers, floods, storms, volcanoes, revolutions, dams, annual maintenance and repairs, and last, but not least, an escape from all engineering problems, there being but one, that of a tunnel, or in case of the Sassardi route, the width of the open cut to give the proper slope, if that should be deemed essential. It may be that in this freedom from engineering problems consists the main objections of the expert commission to these routes. With no vast engineering difficulties to overcome there can be no great glory accruing to the eminent engineers who overcame them, but the advantage in economy of construction and maintenance and in facility of use and short time of passage, I apprehend, would more than offset the disadvantage of not being compelled to solve difficult problems.

N. W. Bliss.

January, 1901.

A USEFUL DIAGRAM FOR CEMENT MAKERS.

The following diagram is submitted as a simple and labor-saving device for properly proportioning the weights of raw materials to be used, to obtain a mixture having a certain definite composition; having given the analyses of the raw materials.

The problem, as above stated, is simply a problem in alligation, but it is one which occurs so often to the cement manufacturer that any shorter method of solution is usually quite welcome. In order to show how the diagram was developed, we may take the following specific problem:

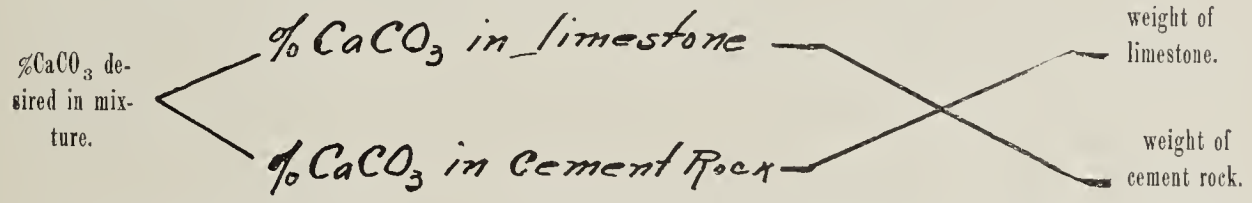
What proportionate weights of a limestone containing 95 per cent $CaCO_3$, and of a cement rock containing 70 per cent $CaCO_3$, must be used to produce a mixture which shall contain 75 per cent $CaCO_3$?

For brevity, let x = weight of limestone in charge
" y = " " cement rock in charge
" a = percentage of $CaCO_3$ in limestone = 95%
" b = " " $CaCO_3$ in cement rock = 70%
" c = " " $CaCO_3$ in mixture = 75%

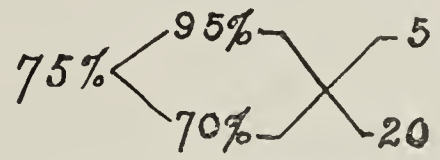
Then by alligation, $c = \frac{ax + by}{x + y}$ or $x(a - c) = y(c - b)$

Whence $\frac{x}{y} = \frac{c-b}{a-c}$ and $x:y::(c-b):(a-c)$, substituting the known values, $x:y::(75-70):(95-75)$, or $x:y::5:20$, or, the weight of limestone to be used is the weight of cement rock as 5 is to 20.

But as algebraic symbols and formula are easily forgotten, the above result may be put in the form of a diagram which is more useful as a labor-saving device, since it is easily remembered.

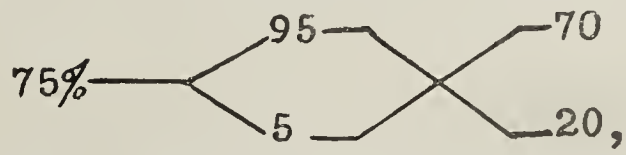


or, supplying the known and desired percentages in the diagram, we have,



Thus by two simple subtractions; in the first instance subtracting the percentage of $CaCO_3$ desired in the mixture for the percentage of $CaCO_3$ in the limestone, and in the second instance, subtracting the percentage of $CaCO_3$ in the cement rock from the percentage of $CaCO_3$ desired in the mixture; and, following the lines of the diagram, setting these results down as shown, we have at once the relative weights of the two materials required to produce the desired mixture.

The diagram would be applied to a mixture of a limestone containing 95 per cent $CaCO_3$ and a clay containing 5 per cent $CaCO_3$ as follows:



showing that for every 70 lbs. of limestone taken there would be required 20 lbs. of clay to produce a mixture containing 75 per cent $CaCO_3$.

In the modern cement factory the raw materials are usually delivered to the mixer by automatic weighing machines, and this diagram gives at once the weights at which each machine must be set to get the desired mixture. It may also be used to get the relative weights of material to be used to get any desired percentage of CaO in the finished cement, and in fact to any like problem in alligation alternate.

The writer does not know who originated the above diagram, although it has been used by him for the past four years.

January, 1901. Herman C. Cowen.

Cayuga Lake Cement Co. has been organized at Ithaca, N. Y.

An extensive bed of asphalt has been discovered west of Joplin, Mo.

AMERICAN ROCK CEMENT.

By Uriah Cummings.

PRODUCTION.

The reports for the seaaon of 1899 show a healthy growth in the manufacture of natural rock cement, the output being the largest in the history of the industry in this country. The increase in production, amounting to 1,500,000 barrels more than in 1898, was confined mostly to the states of New York and Indiana. The extra demand was but temporary and was not accompanied by an increase in the manufacturing capacity, which is sufficient to produce 12,000,000 bbls. annually.

The following table gives the amouut and value of the natural rock cement produced in the United States during 1898 and 1899. The values are based on the price per barrel in bulk at the various factories. The cost of package is always added to the bulk price of the cement. Approximately 80 per cent of the cement is now sold in jute or paper sacks:

Product of natural-rock cement in 1898 and 1899.

State.	1898			1899		
	Number of works.	Product in barrels.	Value	Number of works.	Product in barrels	Value
Florida	1	7,500	$7,500	1	.....	.....
Georgia	1	18,000	13,500	1	13,000	$9,750
Illinois	3	630,228	220,580	3	537,094	187,983
Indiana and Kentucky	19	2,040,000	816,000	19	2,922,453	1,022,858
Kansas	2	160,000	64,000	2	150,000	60,000
Maryland	4	297,475	118,989	4	362,000	144,800
Minnesota	2	128,436	64,218	2	113 986	56,793
New York	29	4,157,917	2,065,658	29	4,689,167	2,813,500
				19		

MINERAL RESOURCES.

Product of natural-rock cement in 1898 and 1899—Continued.

State.	1898.			1899.		
	Number of works.	Product in barrels.	Value.	Number of works.	Product in barrels.	Value.
Ohio	3	26,724	$13,362	3	34,557	$17,279
Pennsylvania	5	499,956	249,978	5	511,404	255,702
Tennessee	1	10,000	8,000	1	10,000	8,000
Texas	1	11,000	16,500	1	12,000	20,400
Virginia	3	8,835	5,301	3	63,500	38,100
West Virginia	1	42,874	17,150	1	52,727	21,090
Wisconsin	1	379,979	151,992	1	396,291	158,516
Total	76	8,418,924	3,832,728	76	9,868,179	4,814,771

PRICES.

There was an advance of 2.6 cents per barrel over the prices for 1898, which was probably due to the increased demand.

The following table shows the average price per barrel for natural rock cement in bulk at the mills during the last ten years.

Prices of American natural-rock cement from 1890 to 1899.

Year.	Cents per barrel	Year	Cents per barrel
1890	51.37	1895	50.32
1891	47.26	1896	50.80
1892	48.61	1897	46.47
1893	43.87	1898	46.19
1894	48.07	1899	48.79

Average price per barrel for ten years, 48.175 cents.

When it is considered that there have been no trusts or combinations among the manufacturers of natural rock cements, and that the capacity has been in excess of the demand, it is remarkable that the fluctuations in prices during the last ten years should have been so slight. It proves the statement made by the writer in his report for 1898, that the prices of natural cement have been beaten down as far as it seems possible for them to go.

CONSUMPTION.

The following table shows the total number of barrels of natural and Portland cement that have been consumed in this country to January 1, 1900. The figures have been prepared after careful and exhaustive research and will be found approximately correct, and in the absence of any other known table covering the same period may be considered authoritative:

Total consumption of cement in the United States to Jan. 1, 1900

[Barrels.]

Year.	Natural-rock cement.	Imported Portland	Domestic Portland.
To 1830	300,000	.....	.....
1830–40	1,000,000	.....	.....
1840–50	4,250,000	.....	.....
1850–60	11,000,000	23,160	.....
1860–70	16,420,000	21,715	.....
1870–80	22,000,000	748,406	82,000
1880	2,030,000	187,000	42,000
1881	2,440,000	221,000	60,000
1882	3,165,000	370,406	85,000
1883	4,190,000	486,418	90,000
1884	4,000,000	585,768	100,000
1885	4,100,000	554,396	150,000
1886	4,186,152	650,032	150,000
1887	6,692,744	1,070,400	250,000
1888	6,253,295	1,835,504	250,000
1889	6,531,876	1,740.356	300,000
1890	7,082,204	1,940,186	335,000
1891	7,451,535	2,988,313	454,813
1892	8,211,181	2,440,654	547,440
1893	7,411,815	2,674,149	590,652
1894	7,563,488	2,638,107	798,757
1895	7,741,077	2,997,395	990,324
1896	7,970,450	2,989,597	1,543,023
1897	8,311,688	2,090,924	2,677,775
1898	8,418,924	2,013,818	3,692,284
1899	9,868,179	2,108,388	5,652,266
Total	178,589,608	33,376,092	18,841,334

Total consumption, 231,378,151 barrels.

Percentage of each kind

Natural-rock cement	77.38
Imported Portland	14.46
Domestic Portland	8.16
Total	100.00

It will be noted in this table that the growth of the natural cement trade has been steady and uniform, until it has reached nearly 10,000,000 barrels annually.

A record of over 178,000,000 barrels, with failures so few as to be insignificant, is a record of which the manufacturers of American natural cement may well be proud. There seems to be no reasonable doubt that this healthy growth will continue indefinitely. American natural cement has a field of its own, established through eighty-two years of use in over 77 per cent of the cement masonry and concrete laid in the United States.

It is beginning to be understood that the discoveries of really first-class cement rock deposits are few and far between. The writer is aware of but one that was unearthed during 1899, and that was near Chattanooga, Tennessee. This deposit possesses some remarkable

characteristics. It is of enormous thickness, the layers are singularly uniform in their proportions of clay and calcium carbonate, and the texture of rock is exceedingly fine.

After calcination this rock shows the following analysis:

Composition of natural rock cement from Chattanooga, Tennessee.

Constituent	Per cent.
Silica	22.17
Alumina	8.20
Lime	65.68
Magnesia	1.45
Oxide of iron	2.50
Total	100.00

This analysis corresponds to those of the best grades of Portland, and in reality the deposit is a bed of natural Portland similar to that at Boulogne, France, although vastly superior to the latter in the matter of uniformity in the proportions of ingredients, as the deposit in France is made up of large and small pebbles and bowlders, while the Chattanooga deposit is one vast formation of heavy layers lying one upon another to the depth of over 50 feet.

Samples from this deposit were calcined to a white heat in an ordinary try kiln, with the following results in tensile strength per square inch after one day in air and six days in water:

Tests of Chattanooga cement.

	Pounds.
Briquette No. 1	573
Briquette No. 2	696
Briquette No. 3	583
Briquette No. 4	592
Briquette No. 5	637
Briquette No. 6	658
Average	623

A one-day test of one hour in air and twenty-three hours in water averaged 235 pounds. A twenty-eight-day test, one day in air and twenty-seven days in water, averaged 797 pounds.

This is undoubtedly the highest testing natural Portland cement in the world, and with cheap fuel assured (a most excellent coal mine being less than 10 miles away) there is no reason why the Southern states should not be supplied with the very finest quality of both natural and Portland cements at very much lower prices which they have been accustomed.

SEND FOR A COPY—"How to Use Portland Cement." The English Translation of the German Portland Cement Manufacturers' Publication. No user of cement should be without a copy of this standard authority. Sent postpaid on receipt of 50 cents. See advertisement.

The Lupton Portland Cement company, with a capital of $1,250,000, has been incorporated to manufacture Portland cement. E. A. Worthington, Wm. C. Edgar, Walter Higgs, Harry L. Bicking, all of East Orange, N. J., are the incorporators.

The Arroyo Grande Ditch and Water Co. of Arroyo Grande, Cal., are concreting six miles of its ditches south of Downey, Cal. The cement work will cost $10,000. This class of work is winning favor with irrigating companies in the West. This is an entirely new application for Portland cement.

Nature gave men business capacity, advertising sets it to work.

The Georgian Bay Portland Cement company of Owen Sound, Ont., has changed its name to the Imperial Cement Company, limited.

Sixteen cement mills in Clark county, Indiana, have joined the combination known as the Western Cement company, with headquarters at Louisville, Ky., and prices will be advanced. The Indiana Cement company of Charlestown, remains out. All sales will be made through a central office. The manufacturers claim that this is necessary to protect themselves from losing money. The headquarters will be at New Albany, Ind.

Injunction proceedings were commenced in the probate court at Salina, Kas., on January 23, by stockholders of the Salina Cement-Plaster company, to keep one set of officers from ousting another. The company owns a number of the largest plaster mills in the West, operating in both Kansas and Texas. Its Texas mills join those of the American Cement Plaster company, which are controlled by A. Henley and his brother, J. A. Henley, of Lawrence, Kansas. The Henleys recently purchased a controlling interest in the Salina company by procuring Eastern stock. A meeting was held and A. Henley was elected president of the company. The Salina stockholders claim the election was illegal, and the proceedings were brought to keep the new officers from assuming control until next May.

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The cement plaster mill at Laramie, Wyo., is being enlarged. The present output is 2,500 tons per year.

The Alta Portland Cement Co. will erect a building 90 by 150 ft. Large qnantities of materials are now on the ground near Rushylvania, Ohio.

The new power house of the Seattle Electric company will be erected on 3,000 piles. The entire floor area will be covered with eight feet of concrete.

An American syndicate, represented at Vancouver, B. C., by J. Keith Fisher, will probably erect a large cement works at Sidney, Vancouver island, B. C.

The Inman Bros. Cement Works of Akron, O., was destroyed by fire December 24, 1900. The company produced King's Windsor cement for a restricted territory.

The Catskill Portland Cement company of Smith's Landing, N. Y., now has an output of 300 barrels per day. Preparations are being made to increase the capacity to 1,200 barrels per day.

The Eureka Plaster company of Syracuse, N. Y., has been dissolved. Liabilities, $29,515; assets, $23,245. The company was organized in 1890. Four of the company's directors made application for dissolution.

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John C. Robinson has resigned the position of manager of the Art Portland Cement company of Sandusky, Ohio. The following directors were elected: R. E. Shuck, Gustav Jarecki, jr., E. J. Cable, P. J. Walker and A. G. Miller.

Professor Mansfield Merriam of the Civil Engineering Department of the Lehigh University, South Bethlehem, has tendered the use of the university's laboratory to the county commissioners of various counties in Pennsylvania for the purpose of testing the cement used on public works.

Nearly $150,000 in new machinery has been added to the plant of the Colton Portland Cement company of Colton, Cal., is the past six months, making it the most complete of the kind in the United States. Electrical motors with a capacity of 750 H. P. have also been installed and will be supplied with power by the Redlands E. L. and P. Co. The works will run to their full capacity.

ON SALE.—"The Hydraulic Index of the Chatelier Formulas," by S. B. Newberry; and The "Commercial Analysis of Portland Cement," by W. B. Newberry; under one cover. Ready July 10, '98. By mail 25 cents. Address, Cement and Engineering News, 161 La Salle Street, Chicago

CEIVERS FOR CEMENT CO.

Upon the application of Edward A. Schmidt and more than thirty other stockholders of the William Krause & Sons Cement Co., of Martin's Creek, Pa., Judges McMichael and McCarthy of Court No. 3, Philadelphia, appointed Harry C. Gill and Alexander P. Colesberry, receivers, and enjoined the company and its officers from transferring the property and stock said to have been illegally issued. The defendants were Bernard J. Krause, Frederick B. Franks, Charles C. Franks, Joseph F. Rose, James A. Gish, Mary C. Farrell, Florence Franks and the company.

The bill in equity, filed December 29, averred that the company was incorporated in April, 1889, with a capital stock of $600,000, and that while the officers made affidavit that 10 per cent of the stock was paid in only a sufficient amount was forthcoming to defray the cost of incorporation. The bill also asserted that while the books showed that the concern bought the William Krause & Sons' patent pavement plant for $221,734, but $19,000 in cash and about $13,000 in stock were actually paid, the balance going in the form of stock to the officers.

Joseph F. Rose, treasurer of the company, testified that to pay for a little more than $23,000 of stock accredited to him he borrowed the money from the president, and as he was unoble to repay the loan the latter officer took the stock. The witness said he did not see any one else pay for stock on the day $60,000 was asserted to have been paid in. At the time the money was paid to the books for property, the treasurer declared that there was no bank account, and merely memoranda was made of the transactions. The present indebtedness of the company is more than $90,000, while there was $1,000 cash on hand. The other assets were contracts in process of fulfillment and insurance policies of the burned plant of the concern in this city, which are being held in New York on attachments issued by creditors.

William Krause, Jr., the vice-president testified that he and his mother sold the plant of William Krause & Co. to the plant of William Krause & Sons Cement Co. His mother was to get $40,000, but she received only $10,000, and therefore title to the property had not been conveyed to the purchasers. He testified that he was paid for his share $10,000 in cash and $8,000 in stock. The 375 shares of stock in his name, the witness asserted, he had never paid for. —*Philadelphia Press.*

A concrete dam now under conconstruction at Redridge, Mich., will require 8,000 cu. yds. of concrete. The work is being done for the Atlantic and Baltic copper mines.

The new *Inter Ocean* building on Monroe street, near Dearborn street, Chicago, will have concrete floors throughout. The Roebling Construction Co. are now at work installing these floors.

The Buckeye Lime Co. has been incorporated to combine all works now in operation in Lucas county, Ohio, and a new plant will be erected at Genoa, O. Thos. D. Cone, Toledo, O., is president.

Wm. E. Dennis of Detroit has entered suit to recover 100 acres of marl land in the vicinity of Cement City, Mich., forming a part of the holdings of the Peninsular Portland Cement company.

The fossil stone remains of a human being, discovered in Nevada and now on exhibition at Boston, has been examined by experts, who assert the supposed fossil is simply a cast made of Portland cement.

The Edison Portland Cement company of Stewartsville, N. J., has suspended operation on its new plant owing to severe weather. Work on the cut, giving access to the cement rock, will continue.

The Webster Manufacturing Company of Chicago have secured the contract for all the elevating and conveying machinery to equip the new plant of the Northampton Portland Cement Co. at Stockerton, Pa.

Ernest R Buckley, associate director of the Wisconsin Geological Survey, read a paper on "The Future of the Clay and Cement Industry in Wisconsin," before the Academy of Arts, Sciences and Letters of Milwaukee.

The Alta Cement Co. of Rushylvania, O., have leased 221 acres of marl land for 50 years on a royalty of 8 cents per bbl. for each barrel of cement shipped by rail, computed, and to be paid for monthly on the railway bills of lading.

C. E. Mould of the Alpheus Portland Cement company, claims to have discovered a natural bed of soft cement rock underlying the company's marl beds. This material requires no burning, as it can be used in its natural state after being pulverized.

Mr. P. O. Krottnaurer, a well-known cement expert, formerly of Chicago, Ill., now a consulting engineer for the Portland cement industry in Europe, with headquarters at Berlin, Germany, has just completed the erection of a Portland cement plant at Jekaterinov, Russian Caucse.

A new natural cement plant is to be erected at Rossville, Walker Co., Georgia. The raw material to be used is nearly identical with the composition of Portland cement. Uriah Cummings of Akron, N. Y., is an interested party in the enterprise.

The Monolith Portland Cement Co. of Bristol, Ind., have designated the Hon. Wm. P. Williams of Chicago as trustee for the bondholders in the matter of placing a mortgage on the company's holdings for $1,000,000 to be used as a building fund.—*Journal*, Battle Creek, Mich.

The Colorado Portland Cement Co. of Portland, Colorado, has issued a 44-page pamphlet, full of practical information relating to the use of Portland cement, giving specific directions for its use in railroad work, municipal work, private enterprise, mine and mill work, floors and foundations. The pamphlet is distributed gratis.

The Jeffrey Manufacturing Co. has issued a special catalogue and price list of 96 pages, for the sawmill, lumber and woodworking industries, handsomely illustrated, describing conveyors for handling ties, logs and refuse; conveyors of sawdust, wood pulp and other useful appliances adapted to the lumber manufacturing industry.

Lot owners in the city of Chicago have been assessed in the sum of $438,926 for the construction of 525 miles of sidewalks. Nine-tenths of these walks will be constructed of cement during the present year; 107 miles of street paving laid on concrete foundations will likewise be done at an estimated cost of $1,887,-847, assessed upon abutting property.

The Lawrenceville Cement Co., 26 Courtlandt street, New York, are circulating a pamphlet entitled "Beach's Cement; with Certain Evidences of its Value and Success," illustrated, and designating where large quantities of this brand of cement has been used. The company's quarries, kilns and mills are shown by half tone plates, as are its steamer and barges used in transporting its product to the markets. Forwarded on application.

Concrete piles are being used at Southampton, England, in dock construction work. They are driven in place the same as a wooden piling. Each pile has a metallic point or tip, with a rod of iron through the center, terminating in a metallic cap. A cushion of sawdust, deposited on the pile cap, breaks the force of the blow of the pile driver hammer, sawdust being gradually added for the continued protection of the pile head during the sinking of the pile.

HINTS FOR THE PLASTERER.

A practical writer in discussing the work the plasterer has to do says: Many times he will be called upon to plaster a building before the sash are put in their places, and when this is the case it is usual to close up the openings with rough boards, canvas or felt, to keep out heat, wind or rain. These coverings, whatever they may be, should not be taken off until the glazed sash are ready to take their places. There are two reasons for this: First, by opening the windows while the plastering is progressing, and admitting a draft, portions of the work would dry so rapidly that it would crack, warp and break bond. Second, by taking off these coverings the building is left exposed to storms and sudden wind pressure, and if the wind cannot get out as freely as it gets in, it may carry the roof away. We have known of several instances where buildings were unroofed because of the plasterers leaving the windows open on one side and closed on another during a sudden storm.

Frequently the plasterer is called upon to lay ground floors in cellars and outhouses, and it has been suggested that perhaps, when economy is an important factor, the following method might be employed successfully: Take four parts coarse gravel, or broken stones and sand, and one part each of lime and Portland cement, mix well in a shallow box, shoveling it over and over again. The sand, gravel and cement must be mixed together dry. The lime is slaked separately and mixed with the other ingredients in such proportion as will cement the whole mass togeter. Six or eight inches of this mixture is then laid on the floor and spread out level, and when set, another coat is put on, consisting of one part cement and two parts sand. This last coating should not be less than one inch thick, and should be well troweled and made smooth on the surface. This will answer for making the bottom of a cistern that is to be cemented up the sides with a lining of bricks. A cement of one part sand and two parts ashes and three parts clay, mixed with linseed oil, makes a hard and durable substance like stone, and will resist the weather almost like marble.—*Architect and Builder*, Scranton, Pa.

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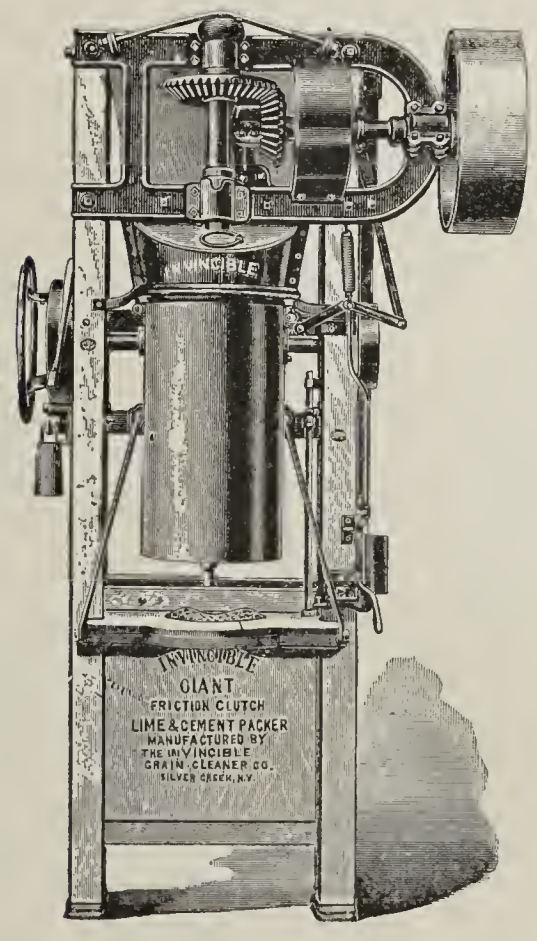

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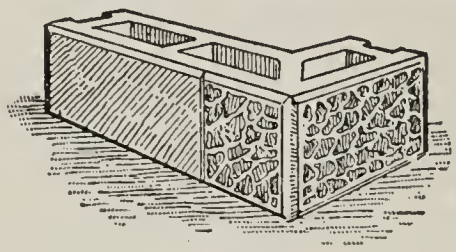

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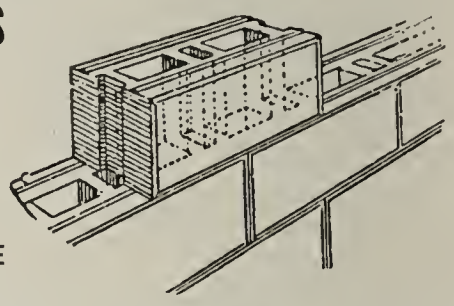

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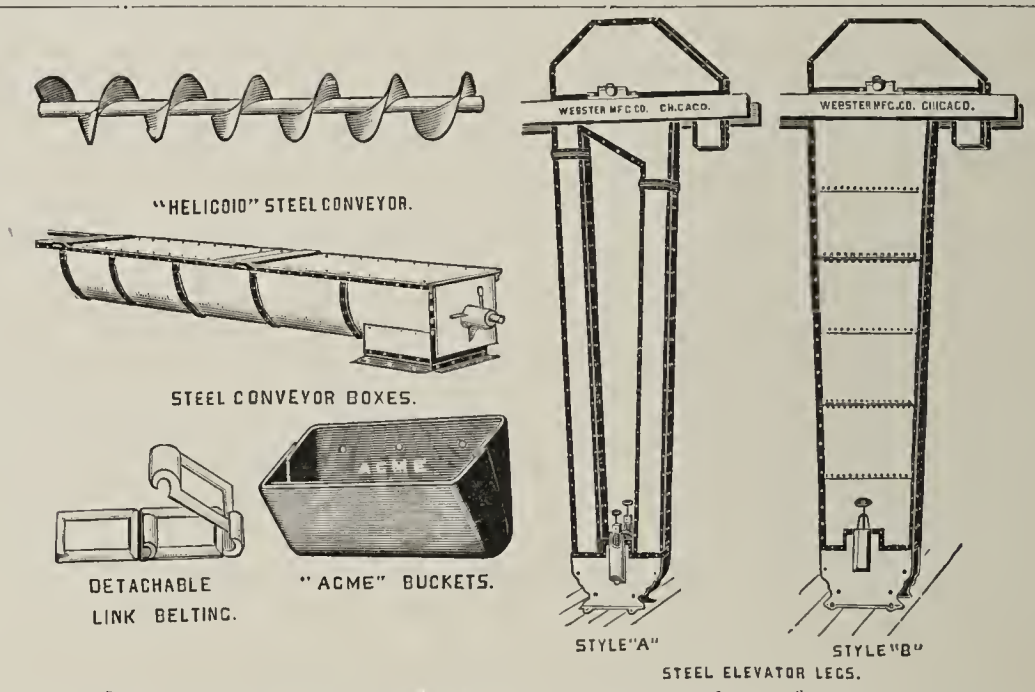

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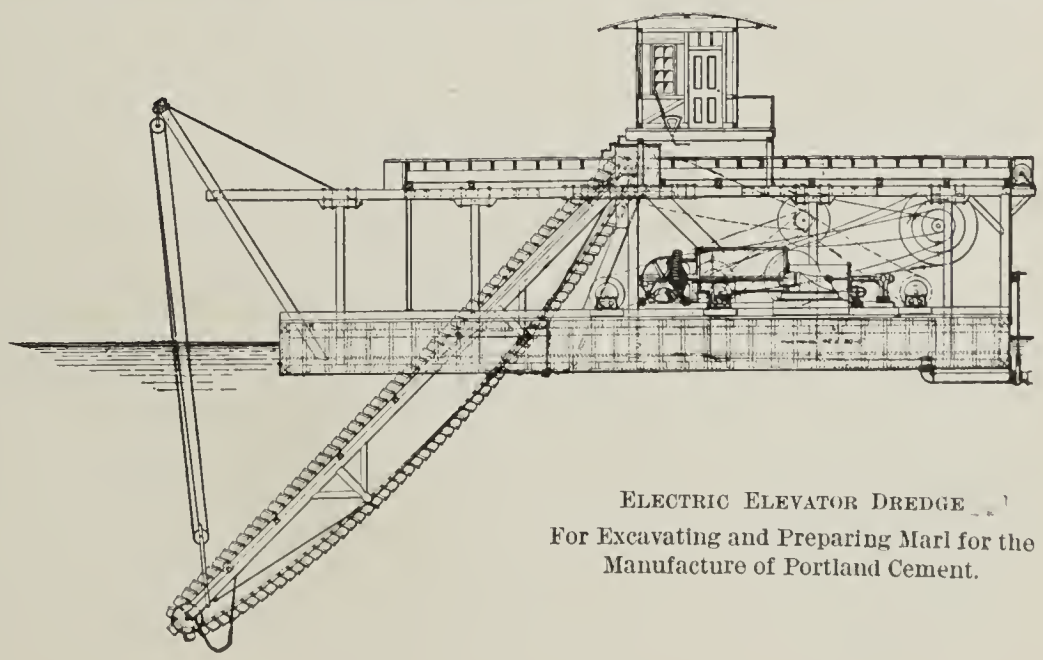

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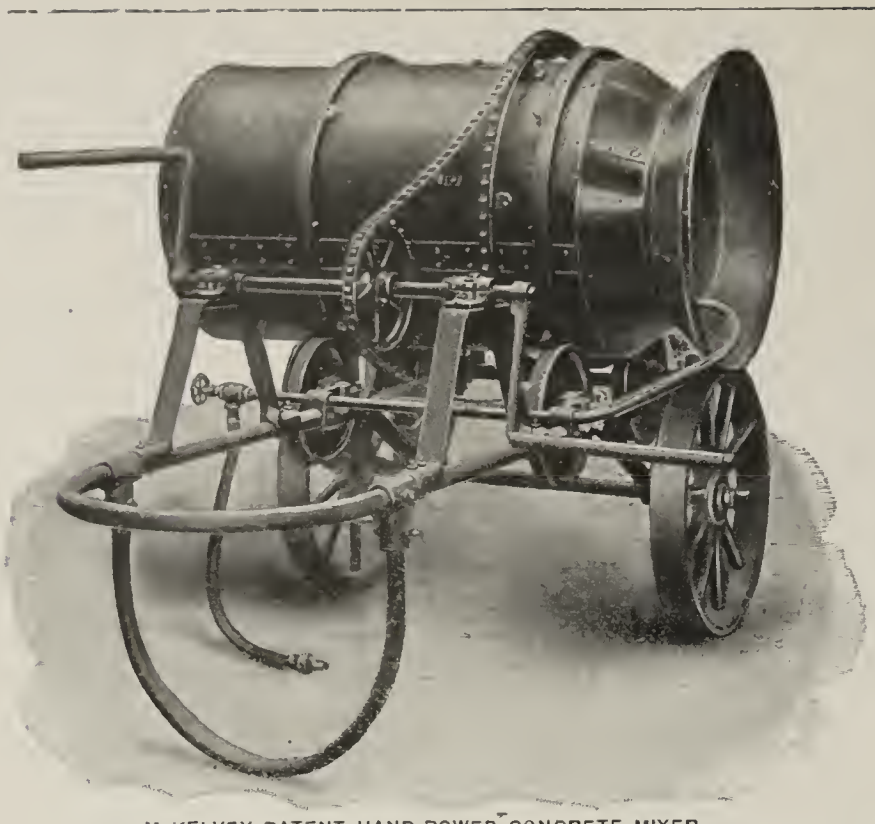

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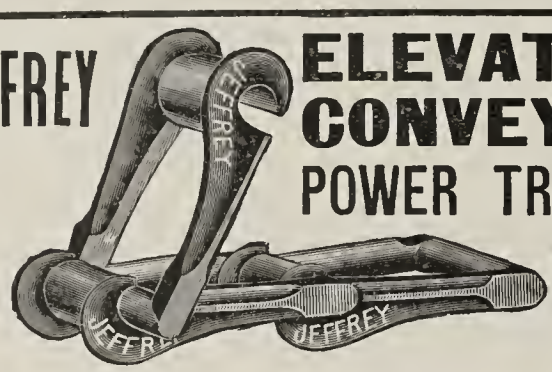

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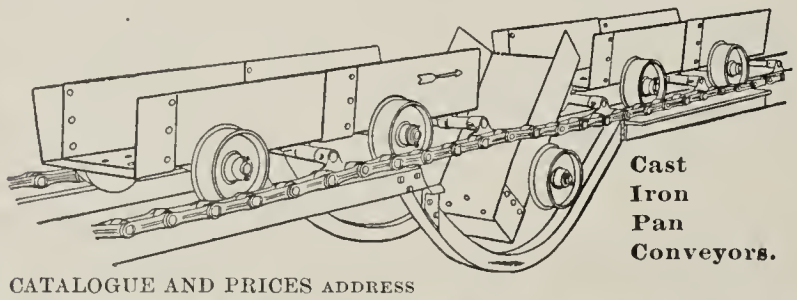

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

AMERICAN CEMENT FOR THE NICARAGUA CANAL.

An amendment to the Nicaragua canal bill now pending in the United States senate provides for the exclusive use of cement of American manufacture. Should the work ever be carried out the United States cement manufacturers will be called upon for from ten to fifteen million barrels of cement to be consumed on the various concrete locks, dams, wiers and spillways on the line of the canal. One of the alternate plans for the Ochoa dam alone calls for the use of 2,000,000 cubic yards of Portland cement concrete for masonry walls, mixed 1, 3 and 6; estimated cost, $9 to $9.50 per cubic yard in place. This dam is located between steep hills and will empound a reservoir of nearly 3,000 square miles of water and maintaining a water level of 112 feet above sea level. This dam must resist the unknown forces of river floods where the average rainfall is 25 ft. per annum, and a maximum rainfall of 9 inches in nine hours. Under such conditions the construction must be permanent beyond all peradventure. This precaution can be secured by the use of concrete. Should this dam give way navigation on the canal would be suspended for years before permanent repairs could again be completed. The canal commission declare that in the event of such failure the destruction of persons and property from the dam to the sea would be complete. Therefore, loose rubble construction as originally prepared for this dam on grounds of economy is not permissible. That a substantial concrete wall must be embedded in the embankment from end to end and carried well into the abutment of the hills alone will answer. The slope of the earth embankments will require protection either by stone or concrete facings against the effect of wash due to the heavy rainfalls. Either stone slabs or concrete facings will be used to give the required protection.

EXPERIMENTAL CONCRETE ELEVATORS.

The Peavey concrete elevators at Duluth, Minn., now hold in storage 1,000,000 bushels of grain. Owing to the peculiar methods of construction, the separate bins forming the cluster are required to be charged and discharged so as to maintain a uniform level of grain in the entire system in order to prevent unequal settlement of foundations as well as to maintain and equalize the lateral pressure between the individual bins forming the cluster. This seriously hampers the intake and output of grain, which might have been avoided if a proper system of concrete and steel construction had been used, such as obtain in the Monier elevators of Europe.

We understand that the contractor for these elevators is liable for any faults in construction to the Peavey company. The facts show that experiments are always costly and should be avoided in business transactions involving large sums of money. These elevators represent an investment of $500,000 and upwards.

It is always sound policy to abide by that which has been demonstrated safe and reliable rather than push blindly into new ideas for the sake of pride and personal honor which is likely to follow by striking out into new paths where other peoples' money is to bear the burden of the failure.

Mr. P. B. Beery has been appointed assistant manager of the Sandusky Portland cement company. Mr. Beery is one of the bright and accomplished young men identified with the American cement industry. He was formerly the sales agent of the same company.

There is probably no industry in the United States whose growth from year to year shows such remarkable strides as the cement industry. Any legitimate article of trade has a continued increase in the volume of business year after year, which increase is shown by the quantity consumed per capita. The estimated consumption of cement in 1900 was 75 pounds per capita against 33 93 lbs. in 1890, and 13.04 lbs. in 1880. Those familiar with the increase of concrete construction assert that the estimate is under rather than above the exact amount. Present indications point to a greater increase for 1901.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	DECEMBER.				TWELVE MONTHS ENDING DECEMBER.			
	1899.		1900.		1899.		1900	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	3,008,796	11,951	2,278,800	8,924	79,853,052	309,614	107,168,529	416,937
Belgium..	16,078,127	53,579	42,342,418	135,860	249,659,656	747,448	330,515,725	1,001,122
France	6,700	32	478,000	2,053	6,259,745	22,262	13,083,888	47,793
Germany.....	40,489,175	147,065	30,111,946	110,581	477,598,702	1,693,722	462,220,172	1,722,104
All Other Europe ...	803,600	2,984	1,569,444	3,925	27,269,463	71,676	30,330,661	91,678
British North Am...	43,750	200	2,800	13	1,759,190	8,868	1,806,786	9,396
Other Countries.....	140,000	683	.....	.....	955,500	4,696	9,547,680	41,415
TOTAL	60,570,148	216,491	76,783,408	61,356	843,355,308	2,858,286	954,673,441	3,330,445
Domestic Exports of Cements, bbls.	7,910	15,012	17,771	39,563	81,090	166,073	100,400	225,306

There were 676,342 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on December 30, 1899, valued at $2,282, against 11,650,946 lbs., valued at $40,459 in December, 1900.

Imports of asphaltum or bitumen for December, 1899, were 8,354 tons valued at $29,187; December, 1900—5,676 tons valued at $26,901. For twelve months ending December, 1899, 100,168 tons valued at $319,089; for twelve months ending December, 1900—111,557 tons valued at $404,921.

TEST CONCRETE BRIDGE MODELS.

City Engineer Briggs of Erie, Pa., has been making tests to determine the strength of concrete arches for bridge purposes. A number of small concrete arches 2½ feet square by 1 foot wide and 1½ inches thick at the crown were used. The models were made of different proportions of sand, gravel and cement, the object of the test being to determine the proper percentage of the materials for use in this work.

Four models were made early in January and were allowed to "set" for 30 days. One of these was recently tested in the basement of the city hall, and it required a weight of 1,350 pounds, placed directly over the center of the arch, where the concrete was but an inch and a half thick, to break it down. Another was tested by covering it with damp earth, packed into a wooden frame, to resemble a bridge crossed by a dirt road. It was weighted the full length of the arch with 3,500 pounds, but showed no signs of giving away. The load was then changed and placed over the center and in this position the arch sustained 5,400 pounds. At this point the boxing gave way and the arch cracked.

These tests were made to determine the advisability of using concrete instead of stone masonry for bridging Mill creek at Third street. Engineer Briggs states that the concrete arches have shown remarkable strength, and the tests have been very satisfactory in every way. He has been directed by councils to furnish an estimate of the cost of the Third street work. He states that the work can be done with concrete for far less money than it would take for any other material.

GERMANS SEEK CEMENT MARKET.

A special to the *Chicago Record* from Bremen says: "The conditions prevailing in the domestic cement industry are such as to necessitate large sales abroad, and the latest reports from German consulates in South America state that there are fine opportunities for cement exporters to place their product in the Argentine Republic, where the Rosario harbor works are being constructed on an extensive scale, and also at Bahia Blanca, where other naval improvements are in progress. At Montevideo and other points in Uruguay also chances for large sales of cement exist. The obstacles in the path of German exporters will undoubtedly be the Belgian and American cement dealers, who are understood to be underselling the Germans throughout the whole extent of South America."

CONCRETE CONSTRUCTION.

The practicability of concrete monolithic construction has scarcely been considered by most of our busy architects and engineers, much less investigated. It will no doubt surprise them to learn that this idea was practically worked out and demonstrated over twenty-four years ago, within twenty miles of New York city, and a fine residence erected that has stood the test of time and holds its own to-day. This building is absolutely fireproof, there being no wood whatever used, except for the door trim, etc., even the stairs being constructed entirely of concrete.

Mr. W. E. Ward of Portchester, N. Y., a prominent iron manufacturer of that town, erected in 1875 a magnificent residence, shown in the illustration, a structure almost wholly of concrete.

In a paper which he contributed to the American Society of Mechanical Engineers in 1883, he described at length his method. According to this paper, there was not in use at that time the word concrete as applied to-day. Throughout the article he refers to it as "Beton." The illustration is from a photograph taken in August, 1900, and a careful examination at that time shows the building to be in a remarkable state of preservation. Every part and parcel of the entire structure, including all walls, floors, roofs, interior partitions, piazzas, etc., are concrete.

The concrete was composed of Portland cement, sand and crushed blue stone. The exterior, as well as many of the interior walls, are hollow, and through these spaces a system of heating is applied. In the floor construction, iron beams and rods were used on much the same general principle as that adopted by several systems of concrete construction at the present time.

The cost of the building was somewhat less than the estimated cost of brick and stone work; the flooring of the drawing room of the house, which was 18x36 feet, was only 3½ inches thick, and after years of use shows not a trace of check or cracks

For detailed information on the subject of this house we would refer to Volume 4, page 488, Transactions American Society Mechanical Engineers.

Mr. C. F. Berger has been appointed the Chicago representative of the Sandusky Portland cement company, manufacturers of the Madusa brand of Portland cement. Mr. Berger has been identified with the Portland cement trade in Chicago and vicinity during the past 10 years.

Send in your subscription for the CEMENT AND ENGINEERING NEWS.

The purchase price of the Coplay cement company by a New York syndicate is reported at $1,000,000.

A new arctic expedition is being organized in Austria, under the auspices of the emperor and nobility of Austria-Hungary. A sub-marine boat of special construction, building at Trieste, will be used. It will be propelled by gasoline. The craft will be towed to a convenient point north by an Austrian man-of-war, whence it will make its way towards the pole by sailing on the surface in open water, and when ice is encountered the boat will be submerged, and in this way it will attempt to reach the north pole.

The City of Chicago requires at the intersection of all newly paved streets that a metal plate be set in the curb, giving the name of the street, the date of the completion of the work of paving, the date of the expiration of the guaranty made by the contractor to the property owner, the name of the contractor, and the words, "Report defects or needed improvements to the commissioner of public works, city hall." This idea for the protection of the public against contractors originated in the mind of Alderman Frank T. Fowler.

Bids were opened January 2 by the U. S. engineer at Little Rock, Ark., for 11,000 barrels of American Portland cement as follows: Glucoe Lime and Cement company, St. Louis, $1.82, Lehigh brand, accepted; Alpha Portland cement company, Easton, Pa., $1.87 8-10, Alpha brand; Virginia Portland cement company, 81 Fulton street, New York city, $1.89, Old Dominion brand; Iola Portland cement company, $1.57, Iola brand; Diamond Portland cement company, Cleveland, Ohio, $2.09, Diamond brand; Illinois Steel company, Chicago, Ill., $1.88, Universal brand; Thorne & Hunkins Lime and Cement company, St. Louis, Mo., $1.96, Atlas brand.

Large deposits of magnesite have been discovered in Southern India, and the officers of a Portland cement works at Madras have succeeded in producing a white cement plaster which has magnesium for a basis. This cement can be used for plastering walls, and dries so speedily that rooms are ready for occupancy within forty-eight hours. It can be painted or colored by mixing coloring matter, and it is extremely valuable from a sanitary standpoint, as it can be washed down. The cement is as hard as Portland cement. It is expected that the material, which can be used either indoors or outside, will play an important part in house-building in India.

THE PRODUCTION OF PORTLAND CEMENT.

(By Spencer B. Newberry.)

PRODUCTION.

The product of Portland cement in the United States in 1899 was 5,652,266 barrels, an increase over that of 1898 of 1,959,982 barrels, or 53 per cent. This increase is nearly double that of the preceding year, and shows that the erection of new factories and the extension of those already existing are going on still more extensively than in the past. From present indications, the production in 1900 will show a still greater increase, as a great number of new enterprises are projected. The growth of the industry continues to be most marked in Lehigh County, Pennsylvania, and immediate vicinity.

The following table shows the production of Portland cement in 1898 and 1899 by states:

Production of Portland cement in the United States in 1898 and 1899.

State.	1898.			1899.		
	Number of works.	Product	Value, not including packages.	Number of works.	Product.	Value, not including packages.
		Barrels.			*Barrels.*	
Arkansas	.....	.....	.....	1	50,000	$87,500
California	1	50,000	$100,000	1	60,000	120,000
Illinois	.....	.....	.....	2	53,000	79,500
Indiana	1	2,500	4,375	.....	.....	.....
Maryland	1	10,000	17,500	.....	.....	.....
Michigan	2	77,000	134,750	4	342,566	513,849
New Jersey	2	587,163	1,027,535	2	892,167	1,338,250
New Mexico	.....	.....	.....	1	1,500	4,500
New York	7	554,358	970,126	7	472,386	708,579
North Dakota	.....	.....	.....	1	1,700	5,100
Ohio	6	265,872	465,276	6	480,982	721,473
Pennsylvania	8	2,095,141	3,142,711	9	3,217,965	4,290,620
South Dakota	1	31,000	62,000	1	35,000	70,000
Texas	1	8,000	24,000	.....	.....	.....
Utah	1	11,250	22,500	1	45,000	135,000
Total	31	3,692,284	5,970,773	36	5,652,266	8,074,371

In the above table the figures for 1898 include the product of three factories manufacturing slag cement, a mechanical mixture of blast-furnace slag and slaked lime, sold by the manufacturers under the name of Portland cement. All authorities agree, however, that this product is not Portland cement. It has, therefore, been omitted from the table for 1899, and is described as slag cement in a later paragraph.

It will be seen from the above table that the manufacture of Portland cement has been resumed in Arkansas after a year of no production. Illinois appears in the field for the first time, with two factories, and will undoubtedly play an important part in the future development of the industry. One small factory in Indiana was shut down during the year, and the State shows no production. Two large factories are under construction, and there is no doubt that Indiana will soon be a large producer. Pennsylvania and New Jersey show, as usual, a great increase in their large production, and this region still maintains its place as the chief center of Portland cement manufacture in America.

The following table shows that the Lehigh Valley region, in Eastern Pennsylvania and Western New Jersey, still holds its own in relative output. This region, which lies wholly within a circle 15 miles in radius, with Bethlehem as its center, is the seat of the first successful establishment for the manufacture of Portland cement in this country, and has from the first shown a larger production than all the rest of the United States combined. As explained in previous reports, this is due to the occurrence in that neighborhood of an immense deposit of clay-limestone, belonging to the calciferous formation, which has nearly the composition of a Portland cement mixture. There are at present eleven factories in this region, two of which are larger than any other works in the world. One of these factories is producing over 8,000 barrels a day, and is increasing its capacity still further. No large deposit of similar material has been found elsewhere in the United States. The Central and Western states are, however, abundantly supplied with materials equally suitable for the manufacture of Portland cement, and some localities are more advantageously situated in respect of fuel supply than the Lehigh Valley region. It is probable, therefore, that other sections will show a greater relative increase in the near future, and that the pre-eminent position of the Lehigh region will not always be maintained:

Development of the Portland-cement industry in the United States since 1890.

Section	1890.			1894.		
	Number of works.	Product.	Per cent.	Number of works.	Product.	Per cent.
		Barrels.			*Barrels.*	
New York	4	65,000	19.4	4	117,275	14.7
Lehigh and Northampton counties, Pa., and Warren County, N. J.	5	201,000	60.0	7	485,329	60.8
Ohio	2	22,000	6.5	4	80,653	10.1
Michigan	.....	.....	.....	.....	.....	.....
All other sections	5	47,500	14.1	9	115,500	14.4
Total	16	335,500	100.0	24	798,757	100.0

Section	1898.			1899.		
	Number of works	Product	Per cent.	Number of works.	Product.	Per cent
		Barrels.			*Barrels*	
New York	7	554,358	15.0	7	472,386	8.4
Lehigh and Northampton counties, Pa., and Warren County, N. J.	9	2,674,304	72.4	11	4,110,132	72.7
Ohio	6	265,872	7.2	6	480,982	8.5
Michigan	2	77,000	2.1	4	342,566	6.1
All other sections	7	120,750	3.3	8	246,200	4.3
Total	31	3,692,284	100.0	36	5,652,266	100.0

Referring once more to the table, we see that there has been a considerable reduction in the product of New York. This is perhaps due to the fact that the works in that state use vertical kilns almost exclusively and that these are less favorably adapted than the rotary kiln to increase of output and economical production. The product of Ohio shows a steady and rapid growth. Michigan, which produced nothing until 1896, is rapidly taking an important place in the list. In other sections the development of the industry has been comparatively slow, though Indiana, Illinois and Kansas will soon contribute extensively to the total product of the country.

IMPORTS.

The imports of Portland cement in 1899 were 2,108,388 barrels, an increase of 94,570 barrels over the quantity imported in 1898. This increase may seem surprising in view of the greatly augmented domestic production, but is explained by the extraordinary activity in building operations which prevailed during the year. There is also a certain class of consumers who will have nothing but imported cement. These are chiefly foreign sidewalk masons in the smaller towns. In spite of the high quality and established reputation

of the best brands of American cements, there are still a few engineers who specify imported Portland exclusively for all work done under their supervision. The high quality of several domestic brands is so fully established, and the guaranties of the manufacturers are so substantial, that this attitude can now only be characterized as narrow and unprogressive. The best grades of German cement are sold at prices which are from 50 cents to $1 a barrel higher than those of American Portland cements at least equal in quality.

The following table shows the imports, by countries, in 1897, 1898 and 1899:

Imports of cement into the United States in 1897, 1898, and 1899, by countries.

[Barrels.]

Country.	1897	1898.	1899.
United Kingdom	344,336	241,198	199.633
Belgium	529,686	651,204	624,149
France	19,319	17,294	15,649
Germany	1,109,280	1,032,429	1,193,822
Other European countries	46,916	51,582	68,348
British North America	4,907	4,635	4,398
Other countries	36,480	15,476	2,389
Total	2,090,924	2,013,818	2,108,388

It will be noticed that the imports from Great Britain show a still further decline from those of former years. The imports from Belgium have also slightly declined, while those from Germany have increased. The quantity imported from other countries is relatively small.

RELATION OF DOMESTIC PRODUCTION TO IMPORTATION.

The amount of Portland cement consumed in the United States in 1899 exceeded that in 1898 by 1,981,012 barrels. As in the previous year, the demand in the autumn months was far greater than the supply, and much inconvenience was felt by contractors on account of the shortage. High prices were paid, in many cases, for immediate shipments, and important engineering works suffered considerable delay. The same conditions prevailed, to a less extent, in England and Germany, and, as in this country, led to the speedy establishment of many new cement factories. The following table shows the relation of production to imports in 1891, 1896, 1898 and 1899:

Comparison of the domestic production of Portland cement with the imports.

[Barrels.]

	1891.	1896.	1898.	1899.
Production in the United States	454,813	1,543,023	3,692,284	5,652,266
Imports	2,988,313	2,989,597	2,013,818	2,108,388
Total	3,443,126	4,532,620	5,706,102	7,760,654
Exports	.....	85,486	36,732	110,272
Total consumption	3,443,126	4,447,134	5,669,370	7,650,382
Percentage of total consumption produced in the United States	13.2	34.7	65.1	73.9

The exports given in the above table consisted of exports of foreign cements, 29,182 barrels, and of mestic cements, 81,090 barrels; total, 110,272 barrels. It is probable that a part of the domestic cement exported was natural cement and not Portland.

The increase in the proportion of domestic cement consumed to that of foreign manufacture is a striking feature of the above table. It will be noted that only 13.2 per cent of the cement used in 1891 was of American manufacture, while in 1899 this percentage had risen to 73.9. Although imported cements will constantly play a less important part in this market, it will probably be many years before importation entirely ceases.

The following diagram shows the course of domestic production, importation and total consumption of Portland cement in the United States in the last ten years:

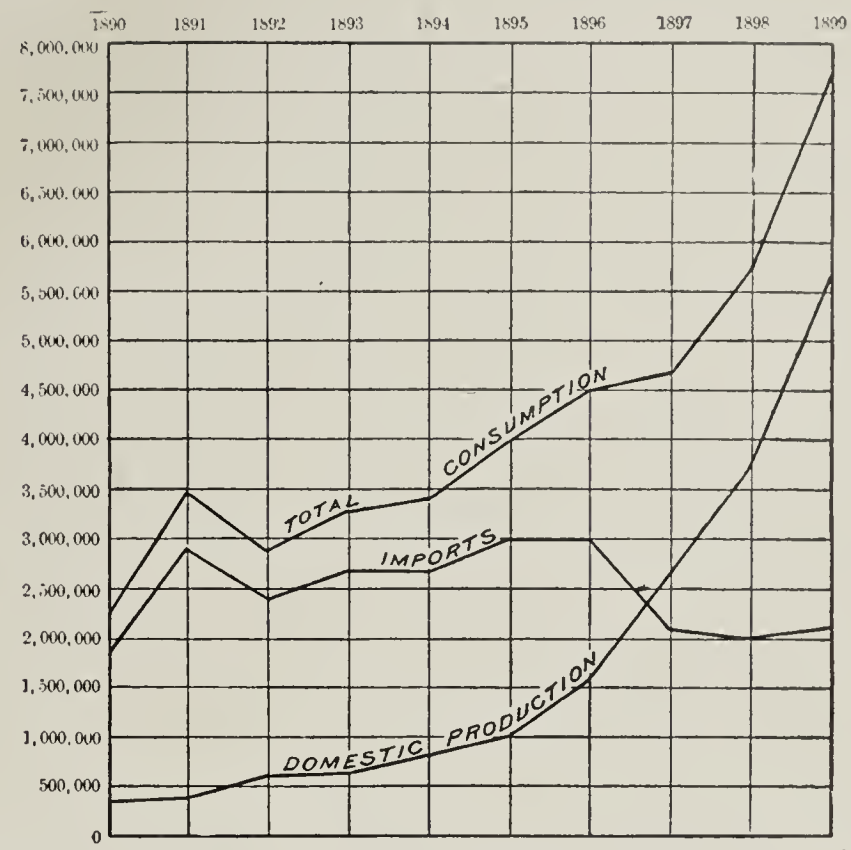


FIG 1.—Graphic representation of the production, importation, and total consumption of Portland cement in the United States from 1890 to 1899.

This diagram shows that the imports of cement, with some variations, have remained substantially constant since 1890. The domestic product, however, which in that year amounted to only 335,500 barrels, or 15 per cent of the total amount consumed, has increased in ten years seventeen times, and now supplies nearly 74 per cent of the demand. It will be noticed that the cement manufactured in the United States in 1899 was almost exactly equal to the amount consumed in 1898, so closely does the production follow upon the heels of the demand. The regularity of the curve of production is most striking, and shows an uninterrupted increase at a constantly accelerated rate. We may well congratulate ourselves upon this rapid development of a great industry, so long as the demand keeps pace with the advance in production. It is to be feared, however, that factories are being established and extended with little consideration of the probable future condition of the market. For ten years each year has witnessed an increased consumption of Portland cement almost exactly equal to the increased output of our factories. It is hardly to be expected that this advance in demand can continue as in the past, at constantly increasing speed. The least check in the extension of the applications of cement, or a year in which the amount used is only equal to that of the previous year, will bring about a sud denand immense over production, with great disaster to the smaller and less favorably situated manufacturers. Whether this will take place next year or the year following can only be conjectured; it is certain, however, that the day of keen competition among American producers is not far distant. The fall in prices which this competition will produce will stimulate the demand for the product, partly at the expense of natural cements. There is no doubt that Portland cement is at present manufactured in this country at lower cost than anywhere else in the world, and this fact, with the extent and magnitude of our engineering enterprises and public improvements, will undoubtedly develop a demand for cement far exceeding that in the

countries of Europe. The production and annual percentage of increase in the last ten years have been as follows:

Production of Portland cement, with increases each year, since 1890.

Year	Product.	Increase.	Percentage of increase.
	Barrels.	*Barrels.*	
1890	335,500	.....	.....
1891	454,813	119,313	35.6
1892	547,440	92,627	20.4
1893	590,652	43,212	7.9
1894	798,757	208,105	35.3
1895	990,324	191,567	24.0
1896	1,543,023	552,699	55.8
1897	2,677,775	1,134,752	73.5
1898	3,692,284	1,014,509	37.9
1899	5,652,266	1,959,982	53.1

The average rate of increase from year to year has been about 40 per cent. This rate continued for four more years would give an annual production of over 20,000,000 barrels, or more than the amount at present made in Germany. That the domestic product has not been restrained by limited demand is shown by the nearly constant imports since 1890. There is good reason to believe that the past rate of increase will continue for at least another year, and that the product of 1900 will reach nearly 8,000,000 barrels. Many new enterprises are projected, and existing factories are rapidly increasing their output. Most of the substantial new projects are located in the Lehigh Valley region, and that section appears likely to maintain its pre-eminence for some time to come. A number of companies have, however, been organized in Michigan, and that state will probably soon become an important producer. The great obstacle to the establishment of large factories in the central portion of the country is the lack of deposits of material of sufficient extent to warrant the investment of large capital. It must be apparent to everyone that the day is rapidly approaching when no factories will be profitable except those producing several thousand barrels per day. The folly of building works upon small deposits of material is, therefore, becoming constantly more evident.

THE PORTLAND CEMENT INDUSTRY IN THE VARIOUS STATES.

ILLINOIS.

Two of the three factories located near La Salle were producing during the last year, and the third, that of the German-American Portland cement company, will be started early in 1900.

In the report of 1898 the statement was made that the Illinois Steel company had practically discontinued the manufacture of cement slag cement. The writer is informed that this is an error, and that the manufacture of this product has been considerably increased. This company proposes, however, to manufacture Portland cement also, by adding to the slag the necessary amount of Bedford limestone and calcining the mixture in rotary kilns.

INDIANA.

The factories of the Sandusky Portland cement company at Syracuse, Kosciusko county, and the Wabash Portland cement company at Stroh, Lagrange county, are in process of erection, and will be put in operation early in 1900.

Works are projected at Bristol, in the northern part of the state, by the Monolith Portland cement company. The materials found at that point have the following composition:

Composition of Indiana marl and clay used for Portland cement.

Marl.	Per cent.	Clay	Per cent.
Carbonate of lime	92.80	Silica	40.56
Carbonate of magnesia	2.19	Alumina	8.52
Siliceous matter	1.61	Iron oxide	2.84
Water and organic	3.58	Carbonate of lime	37.40
		Carbonate of magnesia	2.76
		Alkalies	1.97
		Water and organic	5.95
Total	100.18	Total	100

KANSAS.

Large works are under construction at Iola and will be in operation early in 1900. Limestone and clay will be used as materials and natural gas as fuel.

MICHIGAN.

The Michigan Alkali company is regularly manufacturing Portland cement from the waste or precipitated carbonate of lime produced in causticising soda and clay. The materials are mixed and burned in rotary kilns. The analysis of the materials is as follows:

Composition of materials used for making Portland cement in Michigan.

Waste.	Per cent.	Clay.	Per cent.
Lime	50.60	Silica	46.81
Magnesia	5.35	Alumina and iron oxide	14.21
Silica	1.75	Lime	14.04
Alumina and iron oxide	0.61	Magnesia	3.61
Sulphur	0.10	Sulphur	1.18
Alkalies	0.64	Alkalies	3.04
Loss on ignition	41.70	Loss on ignition	15.75
Total	100.75	Total	98.64

Works are also under construction or projected at Jonesville, Baldwin, Newaygo, Elk Rapids, Alpena, Cementon, Fenton and Three Rivers.

NEW JERSEY.

The Edison Portland cement company at Stewartsville, Warren county, proposes to burn cement in a gigantic rotary kiln, 110 feet in length and 10 feet in diameter. The kiln has been constructed, but is not yet in operation.

NORTH DAKOTA.

The factory and deposit from which the Pembina Portland cement is made are located on Tongue river, in the Pembina mountains. The material is a chalky clay, and geologically belongs to the middle cretaceous. It is soft enough to be mined by the pick, but may be wedged out in blocks weighing several hundred pounds. The material occurs in layers of varying thickness, which outcrop from a hillside. They have a total thickness of over 50 feet. Only certain of these layers are used for cement. The material is taken out by tunneling.

This marl clay varies much in chemical composition. It is therefore necessary to observe great care in selecting and mixing the proper layers. A great number of chemical analyses are made and the essential composition of the different layers worked lies within about the following range:

Composition of marl clay from North Dakota, used for cement manufacture.

Constituent.	Per cent.
Silica	9 to 15
Alumina	4 to 8
Iron oxide	2 to 3
Carbonate of lime	63 to 75
Carbonate of magnesia	1 to 2.5

The different layers are properly proportioned, and after being ground and mixed are burned in a rotary kiln with pulverized coal. The factory has a capacity of 125 barrels a day. The factory is located about 500 feet from the hillside from which the raw material is taken. The plant was designed by Lathbury & Spackman of Philadelphia, and the erection was superintended by Mr. F. D. Wood.

(*To be continued.*)

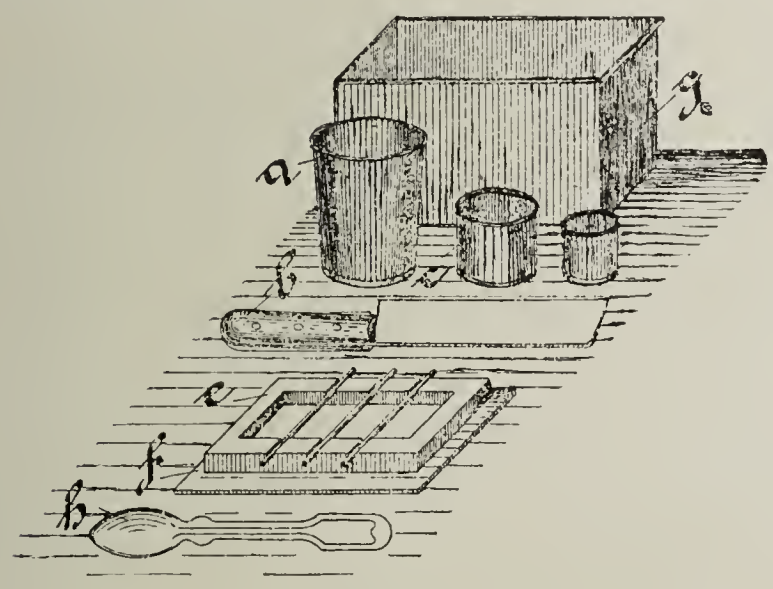
A SIMPLE CEMENT TESTING APPARATUS.

Notwithstanding the daily increasing demand for Portland cement, yet in its use many mistakes are still made, originating in lack of knowledge or in carelessness. Failures are then often ascribed to the quality of the cement. The producer, however, will generally be able to prove the incorrectness of such statements by means of his journals, showing the mill tests made with the cement in question. If every consumer would test his cement before its use and thereby inform himself of its good or bad properties, many failures would thus be avoided.

Some consumers will say that time, occasion and often also practice are missing for such tests. The apparatus described hereafter will be useful in such cases; it enables every one to make the most necessary tests in the shortest time possible and requires no practice whatever.

With this apparatus small plates of cement are formed which render it possible to test the time of setting, the hardening, constancy of volume and, up to a certain degree, even the strength of the cement.

The apparatus consists of: A beaker a (beaker is an open-mouthed vessel with a lip for pouring, as shown in the cut) *a*, a knife *b* for gauging, a beaker *c* for cement, a beaker *d* for measuring water, a mould *e*, inside conical, with three iron rods, an iron plate *f*, a zinc reservoir *g*, a spoon *h*.



German Cement Testing Apparatus.

Before use a sheet of paper completely moistened with water is laid upon the iron plate, entirely covering it. The paper is smoothed, then the mould is laid upon it and held in place by means of clamps. By aid of the spoon the beaker *c* is loosely filled with cement corresponding with about 100 grammes (about $3\frac{1}{4}$ ounces) of cement, which is then put into beaker *a*. Now, beaker *d* is filled with pure water up to the mark that corresponds to 30 cubic centimeter, and also emptied into beaker *a*. The cement is then mixed for two minutes with the water by means of the knife, so that a stiff paste ensues. If necessary a few drops of water may be added to obtain the right consistency, which will be learned after a short practice. The cement paste thus obtained is pressed into the mould, while the mould is slightly struck on the table several times in order to obtain a pat of uniform thickness. The three iron rods are placed into the grooves and the time is noted. After a lapse of one-half to one and a half hours, *i. e.*, after the cement paste has set so far that it is about to become solid, the iron rods are carefully removed by pulling them in their longitudinal direction (they are not to be lifted). From this time the cement is tested by a slight pressure of the thumb nail every 15 to 30 minutes to see if a marked impression is made. If this be no longer the case, the cement is regarded as being set. At this time the hardening process begins at first, lasting for weeks and months. The time elapsed from pressing the cement paste into the mould until its setting is noted with a soft lead pencil on the cement plate, as well as other data referring to the origin and purpose of the cement. The cement plate is left for a half hour longer in the mould and then taken out. For this purpose the mould is lifted at one corner by means of the knife tip slid under it. The mould is then again lowered and removed, together with the cement plate, from the iron plate by a lateral sliding motion. The cement plate, now free from the mould is turned over and allowed to rest in this position for twenty-four hours, counting from the time of making it. The cement plate must be kept in a moderately heated room, protected from draft in order to avoid dessication. When the twenty-four hours have elapsed, the cement plate is placed in the zinc reservoir kept filled with pure water, so that it rests on one edge and is surrounded on all sides by water. After having been kept under water for two to three days the cement plate is taken out, carefully examined for cracks, especially on the edges, which would indicate swelling, and then broken in the middle line.

The two pieces thus obtained are replaced into the reservoir. After three to seven days one of the half plates is broken, and the remaining one after two to three weeks. The four pieces may be kept in air for further observation. The strength necessary to break the plate after two to three days and three to seven days, etc., proves whether or not the hardening goes on regularly.

The apparatus can be be obtained from the "Thonindustrie," Germany, Berlin, N. W. 5, 6 Krupp street.

ENGLISH CEMENT TRADE DIFFICULTIES.

In July last an agreement was made under which the principal London cement merchants agreed, upon certain terms, to take their whole requirements of cement from the Associated Portland Cement Manufacturers, limited. After the agreement had been in operation about six months, the latter gave the merchants notice that they were advised that the agreement was not enforceable. The merchants took counsel's opinion, which laid down that the agreement was enforceable, but the merchants, after considering the difficulties in their way, and the "critical and disorganized state" of the cement trade in London, decided not to enforce their contention. Consequently they have agreed, under protest, to the agreement being cancelled. There is considerable feeling in the trade on the subject, and Mr. G. E. Wragge, chairman of the Associated Cement Merchants of London, 47 Belvedere road, S. E., complains that "this agreement, which was drafted entirely by the manufacturers, and which at any rate was distinctly the understanding upon which the merchants were to be supplied with cement, should now be repudiated by the manufacturers."

A Portland cement and lime plant is under consideration at Portland, Ore. The plant is to be located at Sumas, Wash.

WET AND DRY CONCRETE.

By Irving Hitz, M. W. S. E.
(*From the Journal of the Western Society of Engineers.*)

There is at present a wide diversity of opinion among what are supposed to be our best authorities, as to the amount of water that should be used in mixing concrete.

The authors on this subject disagree radically, and the engineers and building contractors are similarly divided in practice.

To show the diversity of opinion among writers on the subject, I have gathered the following extracts:

Professor Ira O. Baker, in his "Treatise on Masonry Construction," says: "Cements vary greatly in their capacity for water, freshly ground cements requiring more than those that have become stale. An excess of water is, however, better than a deficiency, particularly where a very energetic cement is used, as the capacity of this substance for solidifying water is great."

Mr. Henry Reed, in his "Practical Treatise on Natural and Artificial Concrete," says: "A careful attention to the quantity of water used is desirable if mortar or concrete mixtures are wanted to be of the best character." The author then gives a list of experiments which show that one part by measure of water to three parts of cement gives higher results as to tensile strength than any mixture with more water. He concludes the subject by saying: "These experiments prove, of course, that the least quantity of water used produces the best results."

Fig. 1.

Mr. D. B. Butler, in his new book published in 1899 on "Portland Cement—Its Manufacture, Testing and Use," says: "The amount of water to be used in mixing concrete depends entirely upon circumstances, and no hard or fast rule can be laid down on this point. As a general rule, however, excess of water is preferable to an insufficiency. If too much water is used it will be impossible to obtain a solid concrete, owing to the space occupied by the excess of incompressible water, while, on the other hand, if too little water is used, the mass will not flux properly and will thus be rendered porous. Of the two extremes, an excess of water is preferable as less likely to lead to dangerous consequences."

Mr. John Newman, in his notes on "Concrete and Works in Concrete," says: "An excess of water in concrete mixing is an error, for then the water affects too much the grains of the cement, which should be merely brought to a gelatinous state, separates the particles of cement and sand, delays the hardening and drying of the cement, and makes it more porous than it otherwise would be." In regard to the tensile strength, he says: "The tensile strength of cement is reduced if too much water is used, and the quantity should be as small as possible, consistent with the proper mixing, as strength is thereby increased; but, on the other hand, it has been stated by experimenters that this difference decreases considerably with age."

Fig. 2.

It is very apparent from the foregoing that there is far from a unanimity of opinion among writers on this subject.

When we come to actual practice we find the same variance, and from some recent valuable statistics gathered by the Society of Railway Superintendents of Bridges and Buildings we find the following:

Out of thirty-five of the most prominent railway companies throughout the country who are using concrete to any extent, ten prefer a dry mixture, five prefer a moderately dry mixture, sixteen prefer a moderately wet mixture and four prefer a wet mixture.

In view of this great difference of opinion on this subject, and with the idea of confirming, or perhaps changing, its present practice, the bridge and building department of the Chicago, Milwaukee & St. Paul railway conducted the following experiment:

Two boxes, each three feet square at the base and three feet high, were carefully made of matched and surfaced 2-inch lumber, as nearly alike as possible. They were then balanced 13 feet apart, center to center, on two 8x16 16-foot bridge stringers, with a short piece of rail on the under side of each stringer, and a third piece of rail placed across and under the other two at the central point between the two cubical boxes, on which the whole structure rested. (See Fig. 1.) The boxes were then made to balance while empty by adding weights to the light end, and all was in readiness to receive the concrete which was to be placed in them. In one box was placed a very wet mixture and in the other a dry mixture.

The concrete was made of one part of Atlas Portland cement, 3.24 parts of gravel and 3.65 parts of crushed

limestone. The gravel used was composed of 51 per cent of sand which would pass through a No. 4 screen, and 49 per cent of pebbles ranging in size from ¼ inch to 3 inches in diameter. This made the actual proportions about 1 of cement, 2 of sand and 5 of crushed stone and pebbles. The concrete was mixed by a Ransome concrete mixer, and all the materials used were carefully measured.

In the box containing the wet mixture was placed 4.38 cubic feet of water, 5.35 cubic feet of cement, 17.32 cubic feet of gravel, 19.5 cubic feet of crushed stone—a total of 46.55 cubic feet, and the box held exactly 27 cubic feet, making a reduction of volume due to voids in stone and gravel of 40 per cent. The 4.38 cubic feet of water added is 82 per cent of the volume of the cement used and made a concrete which was very wet, sloppy and awkward to handle, as the wheelbarrows would hold only a limited amount without slopping over.

When deposited in the box it required no tamping, and, when allowed to stand, water would come to the surface. It was purposely given a greater excess of water than would ever be used in actual practice. A part of this excess of water escaped through the cracks and over the top edge of the box when filled.

In the box containing the dry mixture was placed 2.05 cubic feet of water, 4.71 cubic feet of cement, 15.25 cubic feet of gravel, and 17.16 cubic feet of crushed stone—a total of 39.17 cubic feet, making a reduction of volume due to voids in stone and gravel of 31 per cent. The 2.05 feet of water which was added was 44 per cent of the volume, or 34 per cent of the weight, of the cement used, and made a mixture, which, by repeated very hard tamping could be made to quake slightly, and moisture could be seen on the surface of each 6-inch layer after the tamping was done.

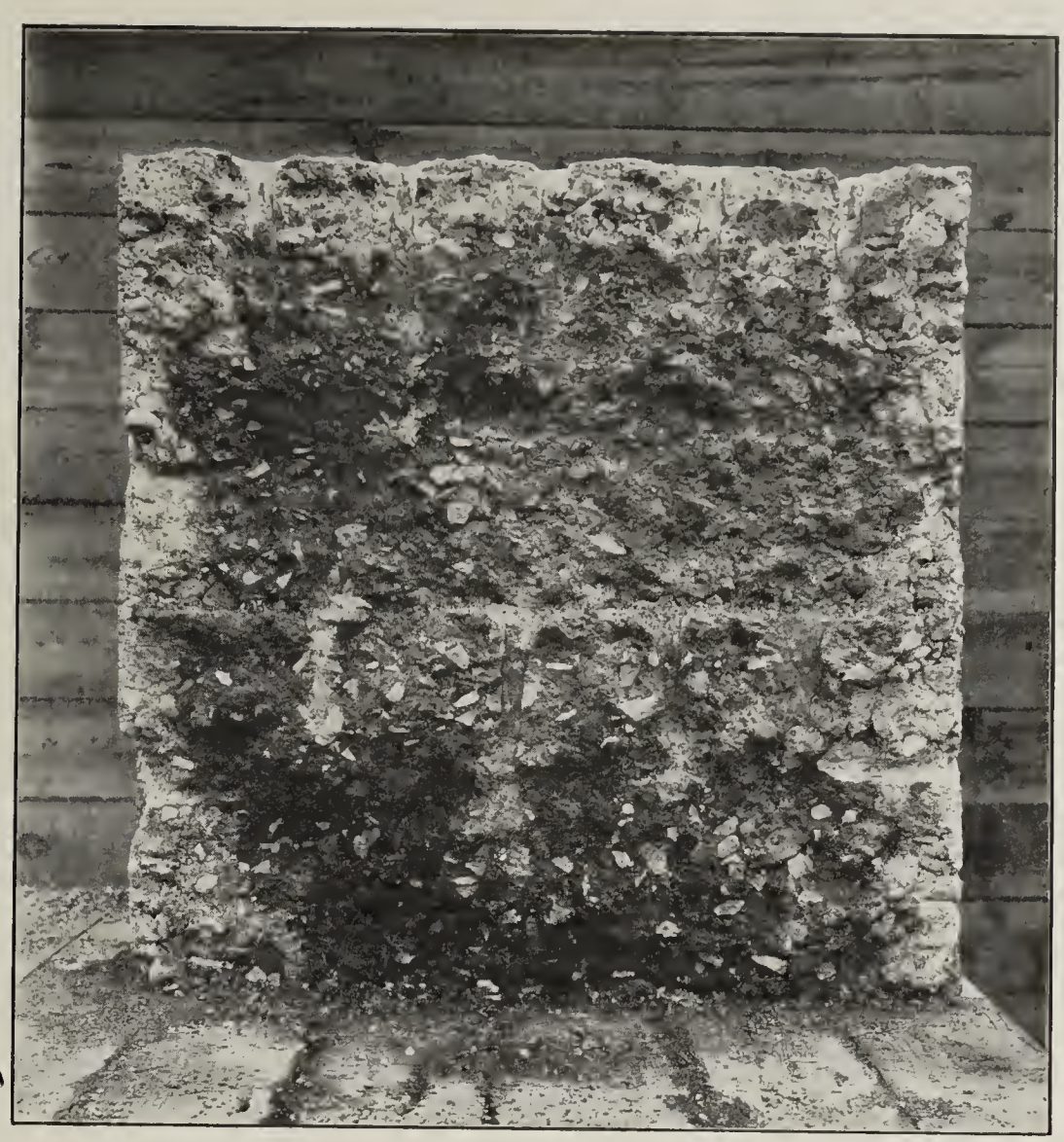


Fig. 4.

Fig. 3.

It required thirty-five minutes to fill the box with the wet concrete; the difference in time being due to the amount of tamping required to properly compact the dry mixture.

As soon as the boxes were filled the blocking was removed so that the weight of the cubes rested on the cross rail, and by means of the jack screw under one end this rail was shifted until the two cubes exactly balanced. It was found necessary to move the center cross rail 0.30 feet toward the cube of wet concrete to effect a balance. This showed that the wet concrete cube weighed 9.7 per cent more than the cube of concrete which had been mixed dry, a difference of about 340 pounds.

When the concrete had set and the frame was removed the difference in the appearance was very apparent. The face of the cube of wet concrete was smooth and compact, while that of the dry cube was full of voids and very rough, notwithstanding the fact that much more time and labor were expended in tamping and depositing

in layers the concrete of the dry mixture.

The cubes were allowed to stand on the balance 30 days. Careful observations were taken to see if the loss of the excess water in the cube of wet concrete would appreciably diminish its weight, but no such loss of weight could be observed.

When the cubes were 30 days old they were broken in the following manner (see Fig. 2):

Five ¾-inch holes were drilled about 6 inches deep across the center of the top surface, and two similar holes were placed down the sides. Ordinary plugs and feathers were then used to crack open the cubes. The same number of holes were used for both cubes, and it was found that the cube of wet concrete was very much harder to break than the other, and the cube of dry concrete broke vertically down to the center of the cube and then the fracture followed the horizontal layer which marked the top of the first batch deposited by the mixing machine. The Ransome mixer contains, when full, about ½ a cubic yard, and there was, therefore, an interval of about five minutes after the first one-half of the box was filled until the rest was put in. This second batch did not make a perfect union with the first one in the case of the dry concrete, and the cube broke along this line which marked the top of the first batch, at first, and had to be redrilled and broken to get the lower half in two parts.

The photographs showing the broken surfaces (see Figs. 3 and 4) of the interior of these two cubes are not entirely satisfactory, as there was more difference in the real appearance of these two faces than is shown by the camera. The interior of the wet cube was a solid and compact mass, with most of the pieces of limestone and granite pebbles broken across along the line of the fractured cube, while the interior of the cube of dry mixed concrete was full of voids and pores, and a much larger percentage of the pieces of stone and pebbles were pulled out of the opposite side of the fracture, instead of being broken as they were in the wet mixture.

This experiment was conducted at 5 p. m. on a warm day, the thermometer reading 80 F., which accounts in part for the large percentage of water used, even in the dry mixture.

The results of this test seem to show:

(1) A moderate excess of water is not injurious.

(2) More labor is necessary in mixing and placing a dry or moderately dry concrete than a wet one.

(3) It is impossible to get a compact concrete without using what is, theoretically, an excess of water.

I believe the practice of using dry concrete to the extent it is used at present has arisen from the fact that laboratory experiments, which are generally conducted on a small scale, under quite different circumstances from the conditions of actual practice, have shown the best results with a minimum amount of water.

The objection that is often raised that an excess of incompressible water must leave voids in the concrete upon evaporation, is not a serious one. The excess of water would not, in actual practice, ever exceed one cubic foot in 27 cubic feet, and, as was shown by the foregoing experiment, there were 2½ cubic feet more of voids in the cube of dry mixed concrete than in the one containing an excess of water.

On exactly the same principle that a hole excavated in the earth can be refilled much more compactly and permanently by the addition of water to the filling than by any amount of tamping of dry or moist earth, so can a more compact concrete be made by the use of a slight excess of water.

A COMMUNICATION.

BRISBANE, AUSTRALIA, Jan., 29, 1901.

Editor Cement and Engineering News:

DEAR SIR:—We are regular subscribers to your valuable journal, and being the largest cement dealers in this city, are naturally anxious to keep ourselves abreast of the cement age.

This city is located upon the banks of the Brisbane river, some sixteen miles above its mouth, and the lower parts of the city are visited every few years by floods which frequently overtake stocks of heavy material, such as cement, iron, etc. In the years 1890, 1893 and 1896 floods visited us, and holders of cement suffered severely—our loss was over 6,000 bbls., the water completely covering the whole of it. Other holders lost over 4,000 barrels. We then commenced experimenting with the water-damaged cement, and found by the ordinary acid test that the lime constituents gave the same action as limestone, and this led us to further experiment by re-calcination, with the result that we made a cement quite equal to the original article. We break up the cement into flakes about two inches thick, and of handy size for the cement kilns. We then burn this with coke to the ordinary cement clinker form, and then pass through rockbreaker, Chilian mill, and finally to tube mill (Schmidt patent). The resulting product is, of course, very fine, the residue being under 5 per cent on a 32,000 mesh sieve. Notwithstanding the fact that the cement is A1, the prejudice against the article is so great that without outside authorities to show that cement which has been set with water resumes its original condition when the water is driven off and the cement re-calcined to the proper point, we can do little.

In your experince, have you met with any similar experiment to that we have related? If none has occurred, is there anything, in your opinion, in the shape of a chemical change by the setting action to prevent the cement recovering its original condition under the circumstances above described; further, is there any reason to fear deterioration of the re-calcined cement with age? We will greatly appreciate a prompt reply because, from our own experience of the article there is no room for doubt as to its first-class character, but we require outside authorities to remove the doubts which exist in the mind of our engineers, architects, etc.

Yours faithfully,
JAMES CAMPBELL & SONS, Ltd.
Jas. Campbell.

We invite information on the subject of the above inquiry for publication.—EDITOR.

A NEW PORTLAND CEMENT MILL.

The Lupton Portland cement company will erect a mill at Lupton, Ogemaw county, Mich., after plans and specifications by A. H. Cederberg of Catasaqua, Pa., with a guaranteed daily output of 2,400 barrels of high grade Portland, which, in effect, means that it will have a capacity of 3,000 barrels.

The process will be a radical departure from present methods of manufacture with marl and clay, concerning which secrecy will be maintained for the present. Krupp machinery will be used exclusively. Rotary kilns of special design will be installed. It is not yet fully decided to equip the entire plant electrically. If, however, guarantees and prices on electrical machinery, either direct or alternating, are satisfactory, electric power will be installed. No contracts have been closed to date and none are likely to be closed before April.

Mr. Cederberg will be at Lupton, Mich., during March and after April 1 at Bay City until the company erects offices on the mill site at Lupton. All inquiries regarding the equipment can be obtained from A. H. Cedeberg as above.

The Hecla cement company is being organized at Bay City, Mich.

TULLOCH & CO. ANNUAL CEMENT TRADE REPORT FOR 1900.

LONDON, January, 1901.

Throughout a greater portion of the year, trade was far from prosperous, over-production being a marked feature, resulting in accumulated stocks and cutting competition. A like condition has obtained in all large centers of production.

GREAT BRITAIN.—The feature of the year has been the formation of the Associated Portland Cement Manufacturers, limited—a company taking over nearly all the chief works on the Thames and Medway, also certain inland mills. If wise counsel prevails, this consolidation will undoubtedly assist in assimilating supply to demand, and contribute substantially to maintaining prices at a remunerative level.

The policy of this company is, we believe, one of defence, not defiance, and when once their huge administrative machinery is in proper working order, trade should run smoothly to the advantage of both manufacturers and consumers.

Home consumption not increasing in proportion to the larger production, naturally affected selling values, which ruled low during the summer and early autumn—varying from 24s. to 27s. 6d. at the works. Owing to the high cost of fuel the London mills were hardly in a position to meet consumers without making a loss. Precisely the same conditions —only perhaps more stringent—apply to manufacturing cost during the current year.

Belgian, and in a lesser degree, German cements competed for British trade, about 110,000 tons having been sold in the United Kingdom.

Export prices started with values ranging from 6s. to 6s. 6d., declining to as low as 5s. 9d., but steadying during the autumn to 6s. 3d. and 6s. 4d. Since the combine was established no actual official announcement as to price has been made, but it is anticipated that rates will rule from 6s. 6d. to 6s. 9d. f.o.b. London for standard brands.

Exports from the United Kingdom were 359,982 tons, showing a slight increase on 1899, but not sufficient to keep progress with the larger output. Exports to the United States have been well maintained, but chiefly owing to an improved demand from the Pacific coast. Buyers there operated largely during the first half of the year. South Africa—a market from which much is expected—took less, while shipments to India showed a fair increase. Australia and South America were normal customers. Last, but not least, shipments to Canada showed a decided increase on previous seasons, due no doubt to the prevailing large amount of government work. Statistics, as given below, may be interesting.

Exports of cement in 1900, with a comparison of quantities for the two previous years:

	1898 Tons.	1899 Tons.	1900 Tons.
Holland	5,477	4,284	4,052
United States of America	46,552	36,715	34,171
Brazil	14,041	15,425	10,336
Argentine Republic	16,171	15,243	17,569
British possessions in South Africa	39,829	40,205	37,620
British possessions in East Indies	45,754	41,309	48,711
Australasia	37,480	36,266	37,398
Canada	13,535	18,610	29,564
Other countries	107,329	144,301	140,561
	325,674	352,358	359,982

Reduction in manufacturing cost, and the gradual installation of rotary kilns, with a thorough up-to-date system of manufacture, will, we have every hope, put the London trade in an even stronger position to compete for the markets of the world.

GERMANY.—An epidemic of over-production, coupled with tightness of money, has caused great depression throughout the trade. The Germans, with their usual prudence, took prompt steps to avert disaster by establishing two important syndicates controlling the general output and the negotiation of sales. These combined syndicates occupy a powerful position, both in regard to the home and export trade. Production has, in the case of some of the larger works, been cut down 40 to 50 per cent. Fixed prices for export have been established, same ranging from Ms. 6.25 to Ms. 6.50, according to brands.

Inland consumption is likely to be moderate, but we look for a steady and increasing export trade. Provided supplies are kept well within the compass of demand, a maintenance of current values, if not an advance, may be looked for.

Export demand was fair during last year, and, although final returns are wanting, we estimate exports will about equal 1899, notwithstanding that certain markets, notably China, have fallen off considerably. The undermentioned figures will form a useful comparison.

Total exports from Germany to undermentioned countries during January to November for the last two years:

	1899 Tons.	1900 Tons.
Holland	39,860	47,360
Austria	19,217	21,643
South Africa	7,905	13,090
Argentine	4,863	9,643
China	24,417	5,141
Canada	7,686	7,202
United States	216,775	186,908

BELGIUM.—While trade in this country has not altogether escaped the general depression, the inland consumption has been fair and exports about normal. Here and there trade has been prejudiced by failure on the part of some of the larger speculators to complete their contracts, but the mills have been careful not to over-produce, and stocks are by no means above normal for the time of year.

A fair trade has been done with the Pacific coast of the United States of America, while the Atlantic coast ports have been comparatively small buyers. Canada has taken its normal complement, while Brazil and the Argentine have bought fairly. Eastern markets have bought rather more sparingly, consumption in India not having equalled expectations.

Prices have about ruled as follows:

Best artificial cements	5s. 10½d. to 6s.
Best natural	5s.
Medium	4s. 6d.

UNITED STATES.—The remarkable growth in the cement industry in the United States is worth recording. To-day the American mills are producing on a low estimate fully 10,000,000 barrels yearly. New mills are springing up in every direction and a large amount of capital is being sunk in this industry. The lesson of "Forward but not too fast" has still to be learnt by the Yankee mills. Many produce only natural rock cements, scarcely suitable for reliable work, but no doubt the ingenuity of the American cement makers will overcome in time, the difficulties in manufacturing a uniform cement. At present it is apparent there is too little discrimination in the employment of American cements for high grade construction.

Stocks remain very heavy, and consequently a decline in price has occurred. Prospects for the coming year for domestic manufacturers is not a very bright one. The building trade, however, is healthy, and we look for a fair demand for known and reliable brands of foreign—and especially German—cements.

In conclusion, we regret that our forecast of twelve months ago as to over-production and decline in prices should have been fulfilled, but we venture the opinion that a more prosperous condition will now prevail, and that prices will advance rather than decline during the present year.

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The Lawrence cement company has improved its plant at Siegfried, Pa., with an installation of a full line of "Invincible" cement packers, manufactured by the Invincible Grain Cleaner company of Silver Creek, N. Y.

Farmers living on irrigated lands in Anaheim Orange county, California, are sending in requests to the Anaheim Water company to have the irrigation ditches lined with concrete, as a great saving of water will thereby be effected during the dry season.

BOOKS RECEIVED.

The Marquette Portland cement company of Chicago, Ill., has issued a beautifully illustrated pamphlet, 64 pages 11 by 8 inches, entitled, "Concrete Experience." The first page gives a skeleton map of Illinois, showing the location of the plant near La Salle, with the shipping facilities radiating from La Salle. The second page shows the company's plant artistically modeled in clay and reproduced in a half tone plate. Seven pages are devoted to groups of portraits of prominent city and civil engineers, jobbers in building materials and contractors and other large users of cement with other illustrations, such as concrete masonry piers for railway bridges, Chicago track elevation work, masonry in large public and private buildings in which the Marquette Portland cement has been used. One plate shows a portion of the kiln room with four rotary kilns in sight. The office laboratory and residence at the works shows the artistic possibilities of concrete for building purposes. The entire pamphlet displays good taste throughout as well as keen business tact in the selection and arrangement of the matters, inasmuch as it does not shoot over the heads of the reader for whom it is intended. The 16-page appendix contains entirely practical matter, relating to the use and testing of Portland cement, under the following heads: "Fill the Voids," "U. S. Government Specifications for Portland Cement," "Specification Used by the Sanitary District of Chicago," "City of Chicago Specification for Combined Curb and Gutter Street Paving," "Portland Cement Foundations," "Wearing Surface Brick or Asphalt." The entire pamphlet is a model in every sense of the word.

Arthur Koppel, 66 Broad street, New York, has issued a comprehensive catalogue, 104 pages, 9 by 5½ inches describing narrow railway materials, fully illustrated, showing the equipment for various purposes, from a spike to a locomotive; to be had on application. Address as above.

J. F. Logan, president of the Twentieth Century Portland cement company, will remove from his present abode and reside permanently at Fenton, Mich., where the company's plant is to be erected.

Eph. W. Fawcett of New Albany, Ind., has been selected as general secretary of the natural cement combine, including mills in Clark and Floyd counties, Indiana, with headquarters at Louisville, Ky.

The Central railroad of New Jersey will erect a large depot at Northampton, Pa., entirely of Portland cement concrete.

The Alsen Portland cement company has completed the purchase of three farms containing cement rock near Nazareth, Pa., upon which cement works will be erected during the coming season.

The statement in our last issue relating to the Edison Portland cement company suspending operations on its new plant applied to the outside work only. The construction is being vigorously pushed without intermission.

Oxnard, Cal., Masons will erect an extensive Masonic temple, Spanish mission style. All outside finish will be of cement. It will contain a theater, library and office rooms, in addition to the several lodge rooms of the order.

The Standard Portland cement company has located the site for a plant at Hamburg Junction, Mich., at the intersection of the Grand Trunk and Toledo & Ann Arbor railways, about midway between Ann Arbor and Howell.

The German Portland cement company of White Pigeon, Mich., has been organized under the state laws. The company includes J. W. Smith, M. D. Bryce and Harry A. Clapp, all of Detroit. Two hundred thousand shares will be placed for sale.

A petition has been introduced in the Connecticut state legislature asking for the incorporation of the Chickamauga cement company by Uriah Cummings and others. The works are now under way at Rossville, Ga., near Chattanooga, Tenn.

Incorporated: New England Concrete, Roofing and Egg Preserve company of North Berwick, Maine, capital stock $10,000, to build sidewalks, concrete walks and streets, put on slate and tin roofings and to preserve eggs. Promoters, D. H. Varnum, Athol; F. E. Varnum, Manchester, N. H.; F. H. Kimball, Londonderry, N. H.; E. P. Spinney, North Berwick, Me.

Several changes in officials and employees have taken place at the plant of the German American cement works at La Salle, Ill., recently. At a meeting of the stockholders, which was held in Germany in December, Geo. C. Prussing of Chicago was elected vice-president to succeed George Kellerman, who has held the office since the building of the works began. Mr. Prussing returned from Germany the first of the week to assume his duties. Mr. Kellerman has returned to Europe.

D. W. Rudle of Fair Haven, Wash., has awarded the contract for the erection of the kilns for his cement works at Sumas, Wash.

The Chickamauga cement company's mill building at Rossville, Ga., is finished, and the boiler and engine house will be finished by March 1. Work on the warehouse and other buildings is also in progress. The boilers, engines and rock and crushing machinery ordered by this company have been shipped. All foundations for machinery are in place.

The option for the purchase of the Coplay Portland cement works by an English syndicate, which deposited $50,000 as a forfeit, expired December 31 without the purchase having been completed. The money has been divided among the stockholders of the company, amounting to $25 per share. It is now reported that a New York syndicate has purchased the Coplay plant of three mills.

The cement sidewalk contract for the city of St. Paul, Minn., for the season were let January 31 at from 8 to 9 cents per square foot. The wearing surface is in the form of octagon cement blocks laid on a natural cement foundation. These blocks are made during the winter season and carted to the ground as required. This form of sidewalk construction is extensively used throughout the northwest.

The Belgian-Romanian bank has organized a cement company under the name of "Societe Anonyme de Cement de l'Europe Oriental," with a capital of $300,000 of which $200,000 is to be used for the construction and equipment of a plant at Cerna, Voda, Romania. The remaining capital is to be used for operating purposes. One hundred and twenty men will be employed. The output is to vary from 100,000 to 125,000 barrels annually. The company has a 50-year supply of cement rock in sight.

Letters of incorporation have been granted to the National Portland cement company, limited, to operate marl deposits in the neighborhood of Owen Sound. A number of Michigan capitalists, who are connected with the Peninsula Portland cement company, are interested in the Ontario project. The head office of the National Portland cement company, limited, will be Toronto. The share capital is placed at $1,000,000, divided into shares of $100 each. The provisional directors are: William F. Cowham, Jackson, Mich.; P. W. Stanhope, Toronto; William Pinkerton, Toronto; Albert Carman, Stratford; R. H. McWilliams, Owen Sound.

The Sandusky Portland cement company's plant at Syracuse, Ind., is now in full operation.

A natural cement cement mill is to be erected near Alton, Ill., on the site of the old Plasa mills.

Rochester, N. Y., has installed a cement testing laboratory, in charge of William Widman as expert.

The Michigan Portland cement company's plant at Coldwater, Mich., is about ready to start up for the season.

The cement plant of the Michigan Alkali company of Detroit, Mich., will shut down shortly for repairs that will require at least a couple of weeks.

The Glens Falls Portland cement company have sold 50,000 barrels of cement to the Hudson River Water Power company to be used in completing the dam at Spier Falls.

The Los Nietos Irrigation company of Whittier, Cal., has awarded the contract for 3,750 feet of cement ditch to J. C. Sheppard of Fullerton. The cost of the ditch will be over $2,000.

The Blockwell cement company of Peckham, O. T., manufacturers of hard plaster cement, will double the present capacity of their plant. The plant is owned by Wichita, Kas., parties.

W. V. Hamilton, manager of the Iroquois Portland cement company, states the plans for the main building are complete and that work on the new plant will commence about March 1.

The Bronson Portland cement company started up its works at Bronson, Mich., February 1. This is the first Portland cement plant to commence operations this season in Michigan.

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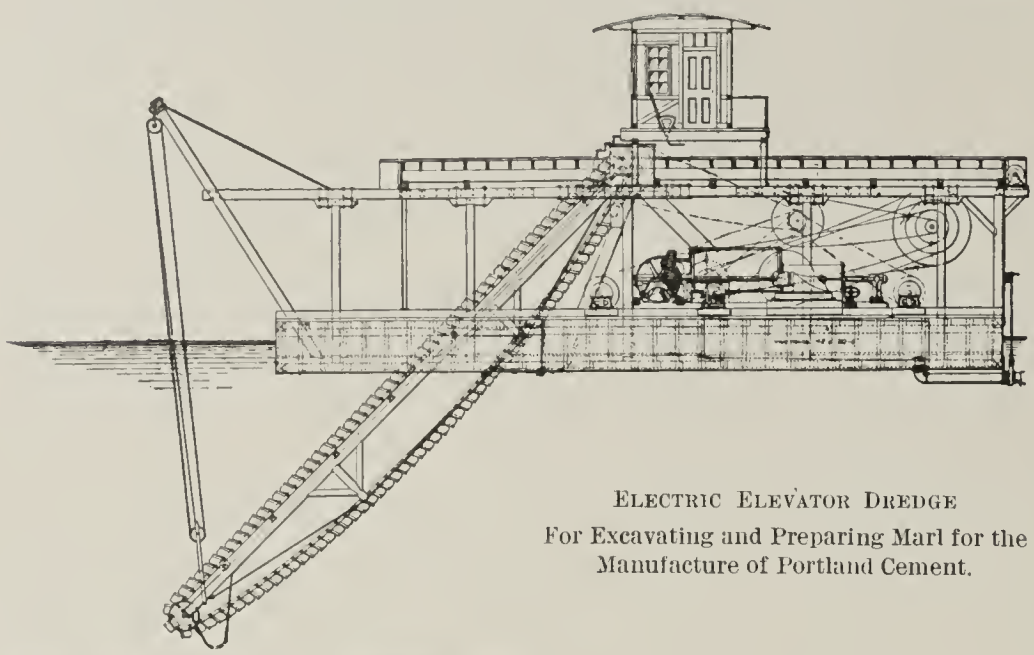

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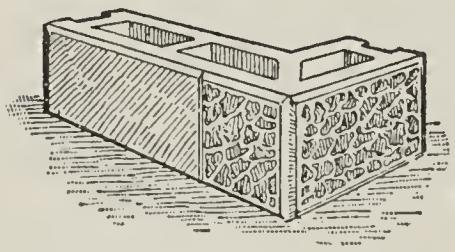

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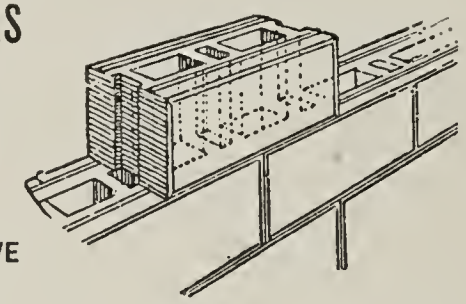

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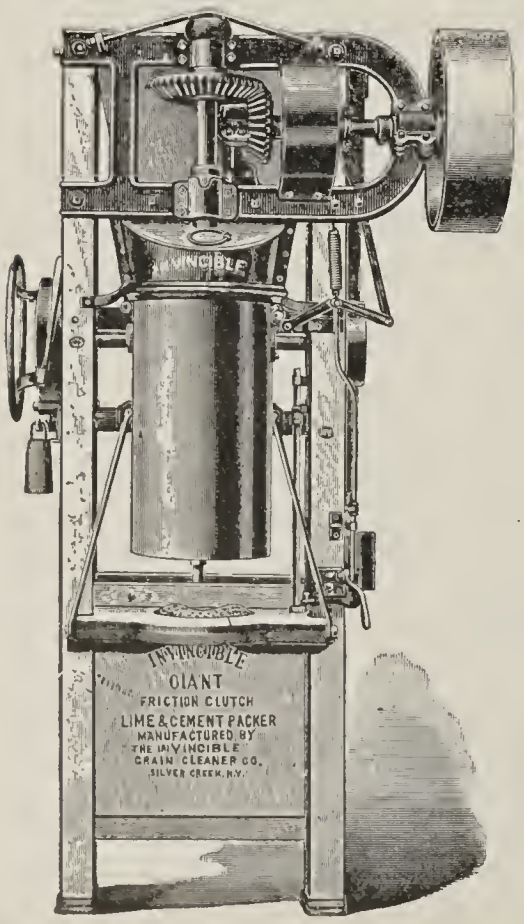

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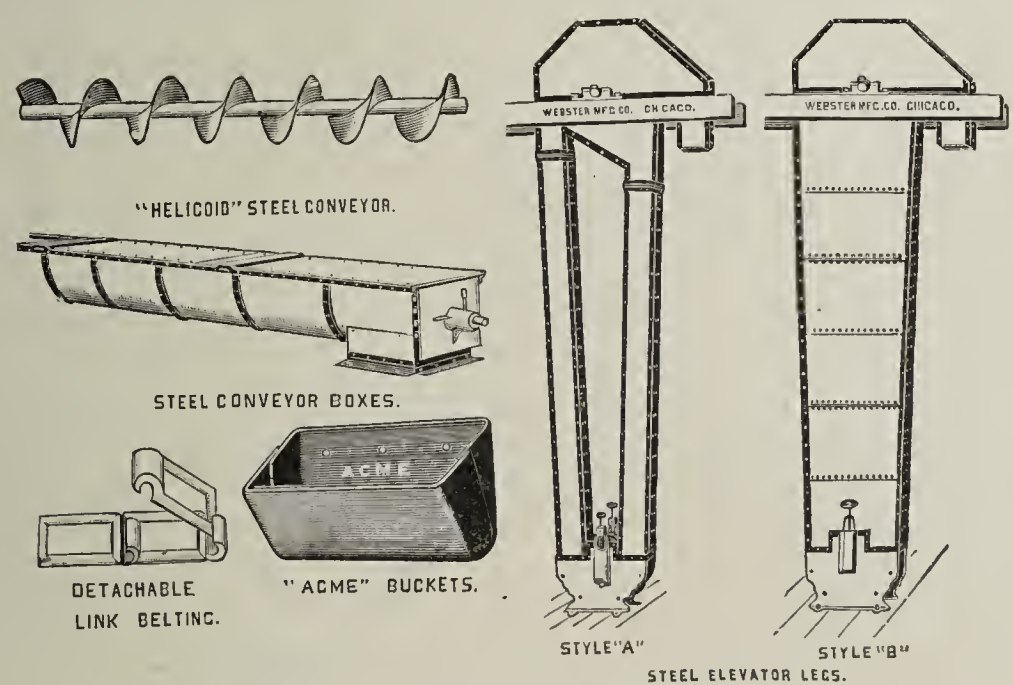

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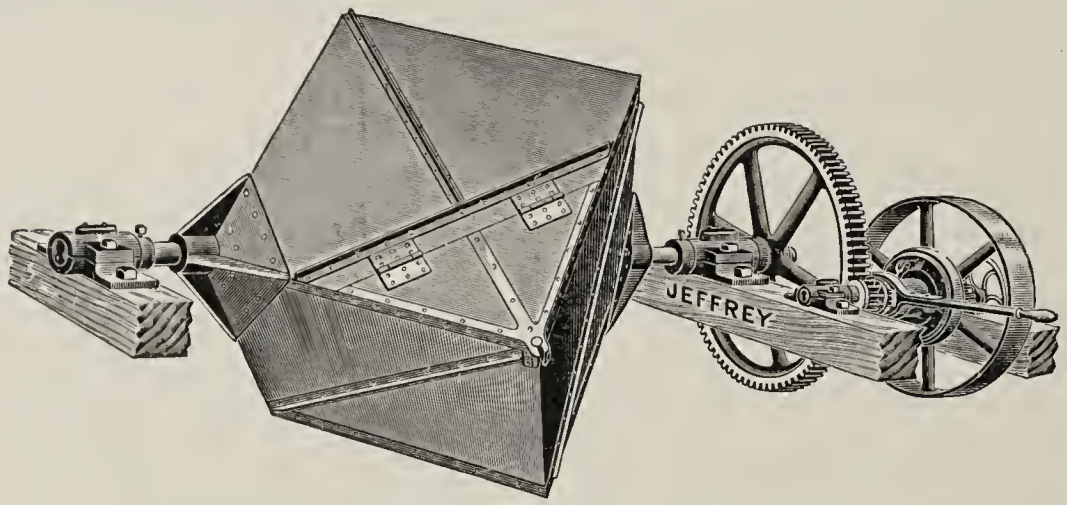

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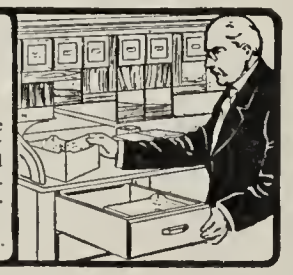

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For the past two years the state of Michigan has been full of Portland cement projects designed to work the numerous marl deposits which extend from the Straits of Mackinac down and across the state in broken areas into Indiana. The local press throughout the state published glowing articles designed to impress fabulous values upon these marl areas and thereby invite capital to embark in their development and reap a golden harvest beyond the dreams of avarice.

In almost every town, village and hamlet in the state there exists a local pride which has for its object the promotion of a cement plant within or adjacent to its own corporate limits. Many of these projects are as unsubstantial as a dream; others will pass into duly authorized incorporations, issue stock and build plants on paper only.

There are a number of Portland cement projects in the state well financed and in capable hands, that will mature and contribute in due season, under proper management, a considerable output. The cost of manufacture in Michigan will average $1 per barrel for a 1,000-bbl. plant. This will leave a small margin on sales and, in the face of a constantly declining market, this margin will be still further reduced.

The available capital in sight for development is not sufficient for the numerous projects in hand, therefore each individual cement project, with few exceptions, is out to knife every other like project afloat in the state, in order to attract the lion's share of the limited available capital into its own coffers. This systematic sowing of discord between the rival promoting companies is undermining the confidence of capital, resulting in several projects now under way suspending operations from the sheer lack of ready money. There are now in being and under construction eighteen Portland cement mills in the state with ten times this number projected, all after outside capital.

PORTLAND CEMENT MANUFACTURE BY CALCINATION.

Our attention has been called to a leading article (editorial) appearing in a reputable monthly journal, entitled "Development of Methods of Cement Manufacture." This article shows how much ignorance can be compressed into three solid columns of the matter on the subject with which it deals. With the end in view of distributing information broadcast that will result in the erection of thousands of Portland cement mills throughout the country, the entire process of Portland cement manufacture is to be given in a certain book about to be published, which is to describe the equipment and process of manufacture of every Portland cement plant in the country down to the smallest detail, and for which information duly authorized agents are now knocking at the doors of various Portland cement mills in vain.

The article in question is simply written as a puff for this book of the near future, which, if consistent with the editorial matter puffing it, will describe a process of Portland cement manufacture by simple calcination. This is as far as the editorial mind has penetrated into the technic of Portland cement manufacture. In our opinion it will be some time before the production of Portland cement by simple calcination will become popular in the United States or elsewhere, notwithstanding all the influence and prestige the editorial force of *The Municipal Engineering* (magazine) which is advocating the process can bring to bear in its favor, since it is based upon entirely erroneous conclusions and will cast dark shadows over the pages of the book they purpose to publish in the interest of the cement industry.

BATES & ROGERS, ENGINEERS AND CONTRACTORS.

Mr. Onward Bates has resigned as engineer and superintendent of bridges and buildings on the Chicago, Milwaukee & St. Paul Railway and has formed a co-partnership with Mr. Walter A. Rogers, at present engineer of permanent construction on the C. M. & St. P. Ry., under the title of Bates & Rogers, civil engineers and contractors, with offices in the Manhattan Building, Chicago.

Mr. Bates has been identified with the civil engineering profession in steel bridge construction since July, 1868, first as draughtsman and inspector of iron work at St. Charles Bridge over the Missouri river and subsequently in charge of building iron caissons for piers of Eads bridge over the Mississippi, and for two years following a student at Rensalaer Polytechnic Institute, Troy, N. Y. In July, '73, he became assistant engineer Baltimore Bridge Co.; November, '74, assistant engineer and inspector of bridges Cincinnati Southern Ry.; March, '77, inspector of iron bridges C. M. & St. P. Ry.; March, '78, Australian representative of the Edge Moor Iron Co., building bridges for colonial governments; July, '82, president Pittsburg Bridge Co.; '84-'86, with the late C. Shaler Smith as assistant consulting engineer; in '87 again with the Edge Moor Iron Co; since February 1, '88, engineer and superintendent of bridges and buildings, C. M. & St. P. Ry. He has had full charge of design, construction and maintenance of bridges, culverts, water supply, etc.

Mr. Bates holds an honorary degree of Civil Engineer from the University of Wisconsin, and is a member of the Western Society of Engineers, the American Society of Civil Engineers, the American Railway Engineering and Maintenance of Way Society, the Institution of Civil Engineering, and of other technical associations.

PHYSICAL PROPERTIES OF NATURAL CONCRETE BRICKS.

By Frank O. Dufour,
Instructor in Civil Engineering, The Lehigh University.

The following is a statement concerning a series of tests on concrete bricks made in the testing laboratories of The Lehigh University at South Bethlehem, Pa., in order to determine their value as a material of construction as compared with ordinary unpressed building brick.

The materials used were limestone screenings of such a size as to pass through a sieve of one inch mesh and remain upon one of half-inch mesh, Natural Cement of good character and sand of a very poor quality being little more than sharp earth. The specific gravity of both stone and cement was determined by Le Chatelier's method and was found to be 2.55 and 2.80, respectively.

The determination of the voids was made as follows: Water being taken at 62.5 pounds per cubic foot, the weight of one cubic foot of solid stone will be 62.5×2.55=159.4 pounds. The average weight of one cubic foot of broken stone was found by actual weighing to be 82.0 pounds. The percentage of voids is now found to be

$$\frac{159.4-82.0}{159.4}\times 100=49.$$

Now 100 parts of stone equal 100 parts of concrete if the voids are just filled with mortar. Taking the factor of shrinkage as one-third we require

$$\frac{49}{3}+49=66$$

parts of mortar when dry to give 49 parts in place. If mortar be taken as 2S to 1C we obtain the following proportions by volume for a theoretically economical concrete: 22 parts cement, 44 parts sand and 100 parts stone or very nearly 1C, 2S, 4R in which C=cement, S=sand and R=rock. The above proportions give a concrete in which the mortar is slightly in excess of the voids.

The method of preparing the tests was as follows: The sand and cement were mixed dry and then thoroughly incorporated with the stone which had previously been wetted with sufficient water to form a film over the entire surfaces. Additional water was now added in sufficient quantity to form a plastic mass. It was now placed in three gang moulds of cherry wood, each mould being 2″×4″×8″, and well tamped into place. The top surface was then smoothed off with a trowel. For a period of twenty-four hours the moulds remained on oiled slate slabs after which the specimens were removed and for each test three were placed in air and three in water.

At the same time three specimens each of neat and of mortar briquettes and of both neat and mortar two-inch cubes made to accompany the brick tests to show their relative value.

In addition to the 1C, 2S, 4R mixture tests were made on bricks having a proportion of 1C, 1S, 1R; 1C, 1½S, 3R and 1C, 3S, 5R.

The bricks were tested for bending flatwise on supports six inches apart and the two halves were then tested flatwise in compression. The sum of the compressive forces on the two halves was taken as the compression an entire brick.

The following tables give the average results in pounds per square inch of the various proportions for bricks, briquettes and cubes together with their relative strength, the strength of the 1C, 2S, 4R mixture being taken as unity:

		Modulus of Rupture. Pounds per square inch.								Relative Transverse Strength.							
Condition of Test.		Air.				Water.				Air.				Water.			
Time of Test.		7 days	28 days	2 mos.	3 mos.	7 days	28 days	2 mos.	3 mos.	7 days	28 days	2 mos.	3 mos.	7 days	28 days	2 mos.	3 mos.
Proportion of bricks.	1C, 1S, 1R	171	253	294	...	125	156	207	...	3.36	9.22	7 16	...	5.44	6.50	2.96	...
	1C, 1½S, 3R	129	61	63	...	75	56	84	...	2.54	2.34	1.53	...	3.25	2.33	1.20	...
	1C, 2S, 4R	51	26	41	48	23	24	70	76	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1C, 3S, 5R	14	23	53	...	9	20	47	...	0.28	0.89	1.29	...	0.39	0.84	0.67	...

		Ultimate Compressive Strength. Pounds per square inch.								Relative Compres ive Strength.							
Condition of Test.		Air.				Water.				Air.				Water.			
Time of Test.		7 days	28 days	2 mos.	3 mos.	7 days	28 days	2 mos.	3 mos.	7 days	28 days	2 mos.	3 mos.	7 days	28 days	2 mos.	3 mos.
Cubes	Neat	1,500	1 000	1,500	1,350	1,130	1,400	1,600	1,900	3.27	3.46	2.17	1.76	3.02	3.32	2.80	2.77
	2S, 1C Mortar	850	650	370	....	475	400	350	....	1.84	1.41	0.62	....	1.27	0.95	0.61	....
Proportion of bricks.	1C, 1S, 1R	1,392	914	1,130	....	916	850	1,013	....	3.02	1.98	1.89	...	2.44	2.01	1.78	....
	1C, 1½S, 3R	1,107	632	401	....	895	662	440	....	2.42	1.36	0.67	....	2.38	1.56	0.77	....
	1C, 2S, 4R	460	462	600	769	375	422	573	686	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1C, 3S, 5R	165	127	477	....	105	121	432	....	0.36	0.28	0.79	....	0.28	0.29	0.76	....

The briquettes tested in tension gave the following results in pounds per square inch:

Neat.

	7 days.	28 days.	2 mos.	3 mos.
Air	186	287	233	200
Water	122	159	248	264

2S, 1C Mortar.

	7 days.	28 days.	2 mos.	3 mos.
Air	84	51	60	..
Water	41	71	76	..

Ordinary building brick have a modulus of rupture of 300 pounds per square inch and an ultimate compressive strength of 2,000 pounds per square inch. From this last statement it would appear that the 1C, 2S, 4R mixture would have a value in three months equal to one-third of that of a common brick and would gradually increase with time. This strength would be ample for an ordinary three-story dwelling house.

Further experiments and the discussion from the manufacturing point of view are probably required before an authoritative statement as to their economy can be safely made.

Plans are under way for a $600,000 cement plant to be constructed for the Tatamy Cement Co. at Nazareth, Pa.

The Newark Lime and Cement Manufacturing Co. of Newark, N. J. has demolished 14 lime kilns that have been in use 65 years on Bridge and Ogden streets, Newark.

Incorporated: The German Portland Cement Co. of Detroit, Mich., to construct works in St. Joseph county, Mich. Capital, $320,000. H. A. Clapp, Cripple Creek county, is the largest shareholder in the company.

Incorporated: The Bound Brook Crushed Stone Company. Capital stock, $100,000. Incorporators: Fred W. Schmidt, Morristown; William Haelig, Bound Brook, and Frank R. Upton, Orange, New Jersey.

Balfour, Guthrie & Co., wheat exporters of Tacoma, have secured an option on 500 feet of water frontage at Fairhaven, Wash., with the object of building cement works which will have a capacity of 300 to 600 barrels per day. All the cement now used on Puget Sound is imported.

An Eastern syndicate has purchased a 170-acre tract of land near Milltown, Ind., about thirty-five miles west of New Albany, on the Louisville-St. Louis division of the Southern railroad, for the purpose of erecting a Portland cement mill. About $100,000 will be invested in the plant.

THE PRODUCTION OF PORTLAND CEMENT.

(By SPENCER B. NEWBERRY.)

(*Continued from February Cement and Engineering News.*)

OHIO.

The Alma Portland Cement company, at Wellston, began operations in April, 1899. The materials are as follows:

Composition of Portland-cement materials from Wellston, Ohio.

Limestone.	Per cent.	Clay.	Per cent.
Lime	54.45	Silica	69.49
Magnesia	0.44	Alumina and iron oxide	16.42
Silica	3.53	Lime	2.29
Alumina and iron oxide	1.14	Magnesia	0.78
Loss on ignition	38.74	Loss on ignition	5.43
Total	98.30	Total	94.41

ACKNOWLEDGMENTS.

For much of the above information in regard to new enterprises and the composition of the materials employed the writer is indebted to Messrs. Lathbury & Spackman, engineers, of Philadelphia, Pa.

SLAG CEMENT.

Slag cement, made by grinding together granulated slag and slaked lime, was manufactured in 1898 at three factories, located at South Chicago, Illinois; Youngstown, Ohio; and Sparrow Point, Maryland. The total product was 233,000 barrels.

MATERIALS.

Composition of Portland-cement materials in Lehigh Valley region.

	Cement rock.					Limestone, Coplay, Pa.
	Alpna, N.J.	Northampton, Pa.			Siegfried, Pa.	
		1.	2.	3.		
Calcium carbonate	70.10	69.24	63.45	67.07	68.91	94.35
Magnesium carbonate	3.96	4.21	4.56	4.06	4.28	2.18
Silica	15.05	19.06	22.22	19.08	17.32	2.14
Alumina	9.02	4.44	7.24	7.92	9.11	1.46
Iron oxide	1.27	1.14	0.92			
Total	99.40	98.09	98.39	98.13	99.62	100.13

The composition of marls, limestones and clays used or to be used at several new factories is stated on the foregoing pages. The question of the relative advantages of marl or limestone as a cement material is one which admits of much argument on both sides. Since Portland cement of good quality can be produced only by artificial mixture of the raw materials in exact proportions, it is obvious that the same result can be reached with either marl or limestone, if of suitable chemical composition. From a mechanical point of view there can be no question that a soft, fine-grained marl may be intimately mixed with the necessary clay far more easily than a hard, crystalline limestone. The drawback of marl is that deposits are usually small and scattered, necessitating irregular working and much transportation of material. Limestone possesses great advantages in extent and uniformity of deposits and in yield of cement from a given volume. A cubic yard of limestone produces about eight barrels of cement, while the same volume of marl yields only about two barrels. Limestone containing approximately the amount of clay required for a correct Portland cement mixture is, of course, a very favorable material, though it is always necessary to bring it to correct composition by careful grinding, with the addition of material higher or lower in lime, as may be required. Such limestone is found in inexhaustible quantities in the Lehigh Valley region of Pennsylvania and New Jersey. This stone is generally deficient in lime, and the addition of from 10 to 25 per cent of a nearly pure limestone is necessary to give the mixture the 73 or 74 per cent of carbonate of lime required. Through the kindness of manufacturers in that region the writer is enabled to give the foregoing typical analyses of Lehigh Valley cement rock and limestone.

The writer's experiments,* based upon those of Le Chatelier, have shown that the maximum of lime allowable in Portland cement may be represented by the following formula:

$$\text{Lime} = \text{silica} \times 2.8 + \text{alumina} \times 1.1; \text{ or,}$$
$$\text{Carbonate of lime} = \text{silica} \times 5 + \text{alumina} \times 2.$$

This maximum can be reached only by extremely fine grinding of the raw materials. In practice the preparation of the materials is always imperfect, and a certain part of the silica and alumina present remains inactive, as is shown by the occurrence of a small percentage of insoluble matter in all commercial cements. For this reason the proportion of carbonate of lime is usually carried about 1 to 2 per cent lower than that called for by the above formula.

As an example of a simple method of calculating cement mixtures, let us apply the formula to the Northampton cement rock No. 1 and the Coplay limestone (assuming the latter to contain 1 per cent of alumina), as follows:

Limestone.

	Per cent.
Total carbonate of lime	94.35
Silica, $2.14 \times 5 = 10.70$; Alumina, $1.00 \times 2 = 2.00$	12.70
Available carbonate of lime	81.65

Cement rock.

	Per cent.
Silica, $19.06 \times 5 = 95.30$; Alumina, $4.44 \times 2 = 8.88$	104.18
Less carbonate of lime contained	69.24
Required carbonate of lime for 100 parts cement rock	34.94

The number of parts limestone required for 100 parts cement rock will then be—

$$\frac{34.94 \times 100}{81.65} = 42.8$$

The per cent of carbonate of lime in the mixture will then be—

In 100 parts cement rock	69.24
In 42.8 parts limestone	40.38
In 142.8 parts mixture	109.62

$$\frac{109.62 \times 100}{142.8} = 76.7 \text{ per cent.}$$

The other samples of cement rock will give practically the same result, varying slightly with the proportion of inert materials (magnesia and iron oxide) present. In practice, from 73 to 74 per cent carbonate of lime is found to be a good working proportion.

The following table shows the comparative preduct from limestone and marl in 1898 and 1899:

Portland cement made with limestone and marl in 1898 and 1899.

	1898.		1899.	
	Number.	Product.	Number.	Product.
		Barrels.		*Barrels.*
Factories using limestone	20	3,112,492	24	4,697,722
Factories using marl	11	579,792	12	954,544
Total	31	3,692,284	36	5,652,266

PROCESSES.

The use of the rotary kiln for burning cement continues to increase, as may be seen by the following table:

*Jour. Soc. Chem. Industry, November, 1897.

Amount of Portland cement made in kilns of various kinds.

[Barrels.]

	1893.	1897.	1898.	1899.
Rotary kilns	149,000	1,311,319	2,170,782	3,711,220
Vertical kilns (continuous and intermittent)	441,653	1,366,456	1,521,502	1,941,046
Total	590,653	2,677,775	3,692,284	5,652,266
Per cent of total product burned in rotary kilns	25.2	49.0	58.8	65.7

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In 1899, rotary kilns were in use at twenty factories, and vertical kilns at sixteen.

The rotary kiln process of cement burning originated in England, having been patented by Siemens in 1869, and was first practically used by Ransome in 1885. The results at first obtained were, however, disappointing, and in spite of the evident advantages of the process, the invention was dropped, apparently with little effort to discover or remove the causes of failure. The higher price of labor in the United States offered a special inducement to experiments in the direction of labor saving machinery, and the rotary kiln was taken up in this country with most encouraging results. At present it appears destined to supplant entirely the older forms of kiln.

The rotary kiln has now and again been introduced into Europe, with the benefit of improvements made and experience gained by American engineers. One has been installed by M. Candlot & Cie, at Dennemont, France; one by J. C. Gostling, and thirty-two by J. B. White & Bros., in England. In Germany, one kiln has been built at Lollar and four at Hemmoor. A full account of the results obtained at the latter factory is given in the report of the last annual meeting of the Association of German Portland Cement Manufacturers. The cement obtained is stated to be superior to that obtained from the Dietzsch kiln, and a saving in cost of manufacture of 44 pfennigs (11 cents) per barrel has already been attained. It appears probable that the use of the rotary kiln in European countries will extend no less rapidly than in the United States.

[THE END.]

COMMUNICATION.

AMERICAN CEMENT COMPANY,
OF NEW JERSEY.
22 SOUTH 15TH ST.

PHILADELPHIA, March 5, 1901.

Cement and Engineering News,
Chicago, Ill.

DEAR SIR:

Noting in your February number, the communication from Messrs. James Campbell & Sons, Ltd., of Brisbane, Australia, in the matter of restoring the vitality of a large lot of Portland cement by recalcination, I take the liberty of giving you, in answer to the inquiry of Messrs. Campbell & Sons, some facts in reference to this branch of the cement business.

In Gen. Gilmore's book on Limes, Hydraulic Cements and Mortars, published by D. Van Nostrand, New York, in 1879, page 169, the following appears:

"Genuine cements that have been injured by age or exposure or have from any cause become wet, may be restored to their original energy by recalcination. For this purpose it is convenient to mix the cement into paste, with about 10 per cent of clay to secure cohesion, and then form it into balls or cakes of suitable size for burning. It is advantageous to mix the clay with the water, as the first step, as its thorough incorporation with the cement is more readily secured thereby. Cement that has become wet through in barrels, and taken a 'set,' as might frequently occur on long sea voyages, may be broken into lumps, re-burnt in that condition, and subsequently pulverized. A bright red heat of 1½ or 2 hours duration is quite sufficient to restore the activity of injured cements.

"Some mortars made from the 'Hoffman brand' (paragraph 60), composed of two measures of cement paste and one measure of sand, taken in the summer of 1859 from the embrasure target, erected at West Point five years previously, was pulverized in a mortar and heated in a crucible for 1½ hours at a bright red heat. It was then mixed in the mortar and formed into two cakes. One of these left in the air, bore the 1-12 inch testing wire, loaded to ¼ pound in ten minutes, and being then immersed, bore the 1-24 inch wire at 1 pound weight in 15 minutes more; the other, immersed as soon as mixed sustained the heavy wire in 55 minutes, though not very well.

"Two varieties of cement, viz: 'Hoffman and the James River brands,' were formed into a paste with fresh water without sand and allowed to harden for three days. They were then re-pulverized and sample cakes of stiff paste formed. Neither of them would sustain immersion in water at all, but appeared entirely deprived of hydraulicity. The sample left in the air bore the light testing wire in about four hours, but they appeared to have hardened more from the effects of desication than hydraulic energy, and fell to pieces soon after immersion in water. Samples restored by a red heat of one hour's duration, were in every respect as energetic as new cements. Numerous trials seem to indicate that cements repulverized after but twenty-four hours induration, are scarcely more energetic than those that remained 'set' three days."

In some very recent English cement literature, there are also some instances of similar treatment of cement.

At the old Coplay Cement Company's works in the Lehigh district, in about the year 1877 or 1878, a large bin of cement was injured by water, had become quite hard and was practically abandoned, but at the suggestion of Mr. J. W. Eckert, the then superintendent and now president of the American Cement Company of Pennsylvania at Egypt, Lehigh county, Pa., this material which it was proposed to throw away, was broken up into lumps, burnt in vertical kilns with coke, ground and pulverized, and it then stood all the tests of a first-class Portland cement.

Another instance of the using of cement which had become caked and hardened for many years, occurred at the navy yard, League Island, this city, under Mr. Thos. C. McCulloh, the then engineer in charge. A barrel of Portland cement which had become thoroughly caked, was found in one of the old warehouses, and after being broken up and dried out by heat, was ground up, and the results of the mortar were practically equal to those of the cement in its ordinary condition, freshly ground.

Trusting this will throw some light on your correspondent's question, I am, Yours truly,

AMERICAN CEMENT COMPANY OF NEW JERSEY,
R. W. LESLEY, *President.*

Among the exhibits from Cleveland, Ohio, at the Pan-American Exposition will be one made by the Brown Hoisting and Conveying Company, which will be included in the Patent Office Exhibit, showing in moving-picture machines the operation of the great carriers. Pictures taken at Cleveland Harbor, where ore is carried long distances from ships to the freight cars, will be reproduced in the picture machines. Another Cleveland invention, which will be seen in the Patent Office Exhibit, is the picture-transmitting apparatus of the Altmutz Picture Telegraphing Company. This will be demonstrated by actual tests. Pictures will be placed on the transmitting apparatus, and will be reproduced at the other end of a telegraph wire strung around buildings.

The Ohio State Historical and Archæological Society has decided to make an exhibit at the Pan-American Exposition. The Society will show Indian and pre-historic relics, as well as a burial ground with exhumed remains, with an illustration of the methods employed in exhuming remains.

Mexico will have an exhibit at the Pan-American Exposition covering, viz.: Agriculture, horticulture, forestry, mines, manufactures and ethnology.

CEMENT TESTING APPARATUS.

(By Dr. W. Michaelis, Jr.)

Although mortars principally have to resist compressive stress in practical use, yet they are mainly tested alone for tensile strength.

The reason for this is, that a certain ratio exists between compressive stress and tensile strength, that generally one increases or decreases at the same time as the other. This rule, however, is not strictly true and if accurate tests are demanded, both compressive and tensile strength should be given. Tests on compressive stress require considerably more time for the making of test pieces; besides, heavy hydraulic presses are necessary to crush them, so that these tests can generally be carried out only at testing stations. The ordinary cement user will usually be unwilling to spend much time for making test pieces, and also will hesitate to secure an hydraulic press. For these reasons recourse is taken to tests on tensile strength.

These tests were previously made with test pieces of different shapes and sectional area. To-day almost the same measurements are customary throughout the globe.

The old time, clumsy apparatus, of which the Riehle machine is a specimen still existing, has been replaced some 25 years ago by a small sized but powerful double lever system originating in the laboratory of Dr. Michaelis, Sr., of Berlin. This machine is used throughout Europe and known by the name Standard Tensile Strength Apparatus. Fairbank's Cement Tester, which makes use of the same lever system, is only a poor copy of the German standard apparatus. It lacks both in finish and construction.

By the following description of the German Standard Apparatus, I would make the reader acquainted with this cement tester and show its varied application for testing, besides tensile strength, also stress of flexion, adhesive strength and resistance against penetration, three kinds of resistances, which in modern engineering, especially in concrete construction, are important factors and are daily attracting more attention.

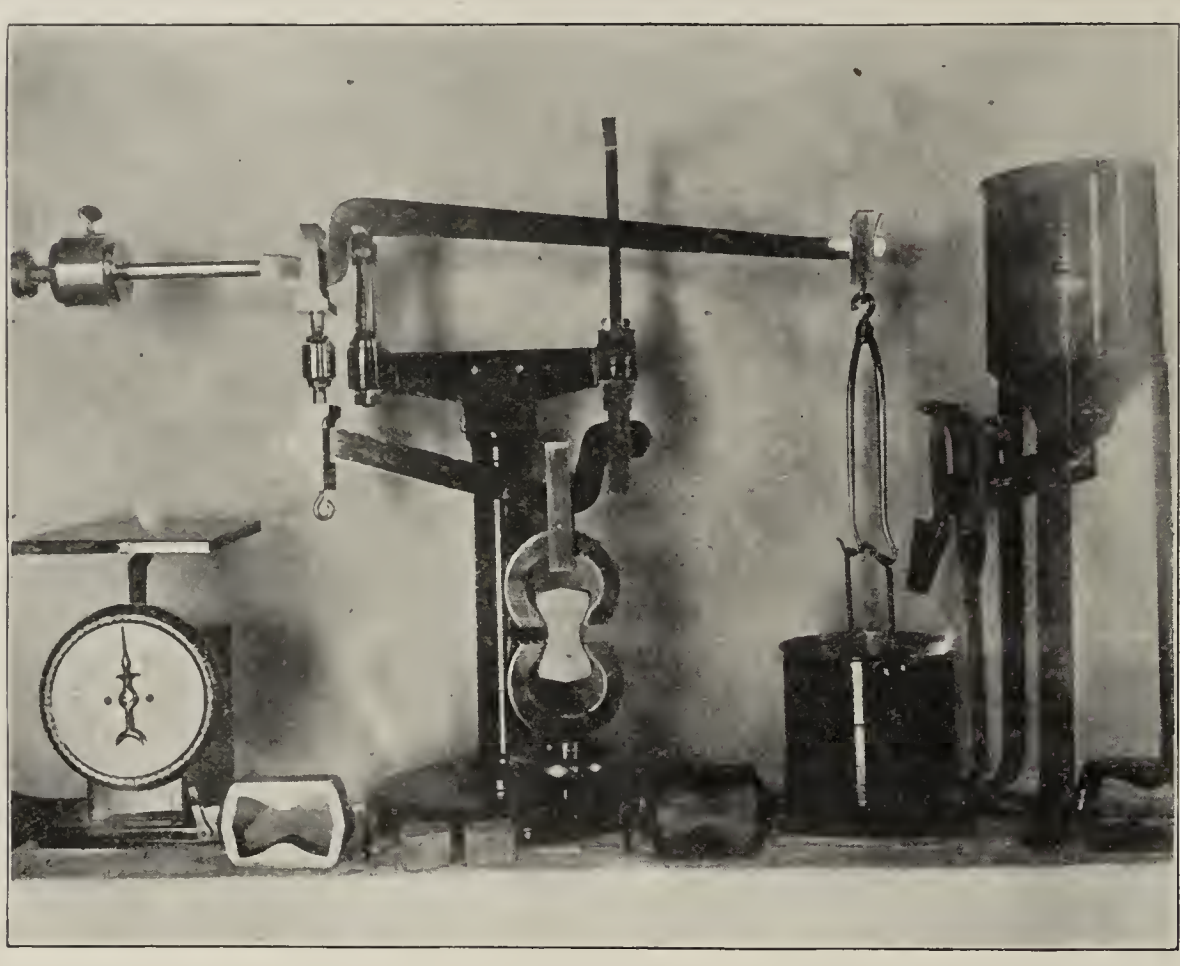

FIG. 1.

1. TESTS OF TENSILE STRENGTH.

Fig. 1 shows the tensile strength apparatus. It consists of a combination of two levers, arranged one above the other, both being supported by an iron stand. The lower lever has a fivefold, the upper a tenfold transmission. Thus a weight of 1 pound at the end of the upper lever corresponds with a pulling stress of 50 pounds at the clamps.

The upper of the clamps engaging the briquette is attached to the lower lever, while the lower clamp is connected by means of a universal joint with an adjusting screw fixed to the base of the iron stand. The two clamps can be separated or caused to approach by aid of a hand wheel. The bearing and gripping points of the clamps are spherical, so that the clamps come in contact with the briquette in four points. The levers are of nickel plated steel. They turn on steel edges, resting in steel pans. All these parts are of the highest precision and well finished. A sliding weight on the left arm of the upper lever serves to bring the apparatus in equilibrium.

In order to secure a uniformly increasing stress, the power is applied by means of shot, which is run from a reservoir into a cup hanging at the end of the upper lever. The quantity of shot running out must be so adjusted by aid of a regulating screw that 100 grammes are run into the cup per second.

After having brought the briquette to be tested in its position, the shot cup is suspended and the apparatus is adjusted by turning the hand wheel, so that the upper lever rises to a point indicated on a vertical steel bar behind the lever. Then the sliding door closing, the outlet of the shot reservoir is opened. The weight of the shot running into the cup presses the lever down, until the briquette is broken. At the same moment the shot cup falls down on a

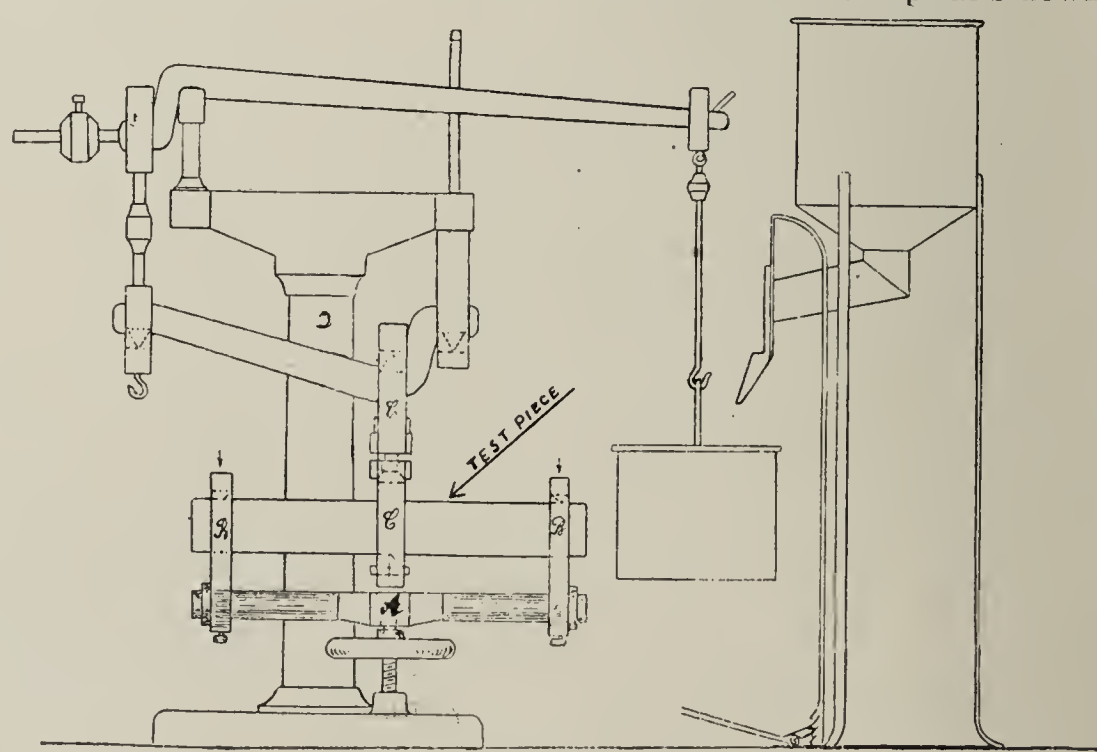

Fig. 2

spring, which held the opened sliding door so long in place and closes the shot reservoir. The cup is then weighed, together with the shot, on accurate spring scales and the weight multiplied by 50.

2. TESTS OF STRESS OF FLEXION.

The stress of flexion is tested by means of test pieces of about 30 centimeter length and a sectional area of 4x4 centimeter or 4x2 centimeter. The arrangement is shown by Fig. 2.

Instead of the lower clamp of the tensile strength apparatus a steel bar, A, is fixed to the adjusting screw. To the cylindrical-shaped ends of this bar there are two frames, BB, attached, which contain two steel edges, the bearing points of the test piece. Instead of the upper clamp the frame, C, is attached to the lower lever. Its steel edge presses against the test piece from below and causes it to bend. The distance of the bearing points and the sectional area of the test piece are so arranged that no final calculations are necessary. For test pieces of a sectional area of 4x4 centimeter the distance of the bearing points is 25.6 centimeter. Then the stress of flexion is thirty times the weight applied to the lever system 1:50. For test pieces of 4x2 centimeter sectional area the distance of the bearing points is 21.33 centimeters and the stress of flexion is, in this case, 100 times the weight of cup and shot.

Fig. 3 shows the same arrangement, with the only difference that here the upper lever 1:10 alone is used and that the edges which form the bearing points are not in frames fastened by means of a steel bar to the adjusting screw, but that these steel edges are attached to two castings rising from the base of the apparatus.

3. TESTS OF ADHESIVE STRENGTH.

Fig. 4 shows the apparatus fitted out for making tests of adhesive strength. In this case two cement pieces must be moulded; one is the body, to which the cement to be examined is to adhere and the other the mortar formed out of this cement. Brick, glass or porcelain have been found to be unsatisfactory as material, to which cement could be made to adhere. The best method for testing adhesive strength is to mould the mortar on a cement block, which has hardened already for some time. These cement blocks are made in the mould represented by Fig. 5 out of 1 part by weight of a good Portland cement and 2 parts by weight of standard testing sand. The cement used for this purpose must have been sifted through the 100 sieve, and only that part which has passed this sieve is to be taken. The pieces are now allowed to set one day in air and from this time in water, until they are used.

Fig. 5

Before use the upper surface of the cement block, that to which the cement mortar is to adhere, is roughened by emery paper No. 3; the cement block is then brought into the mould, shown by Fig. 6, and the mould is filled by pressing in the cement mortar consisting of the cement to be tested for adhesive strength and of standard testing sand in the ratio of 1:2 or 1:3, as desired.

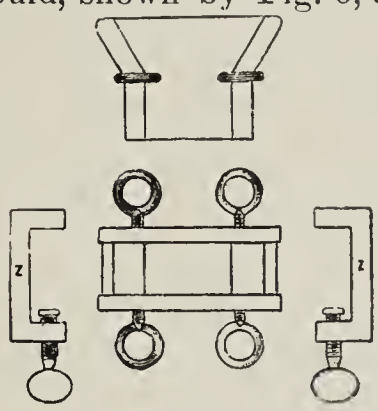

Fig. 6

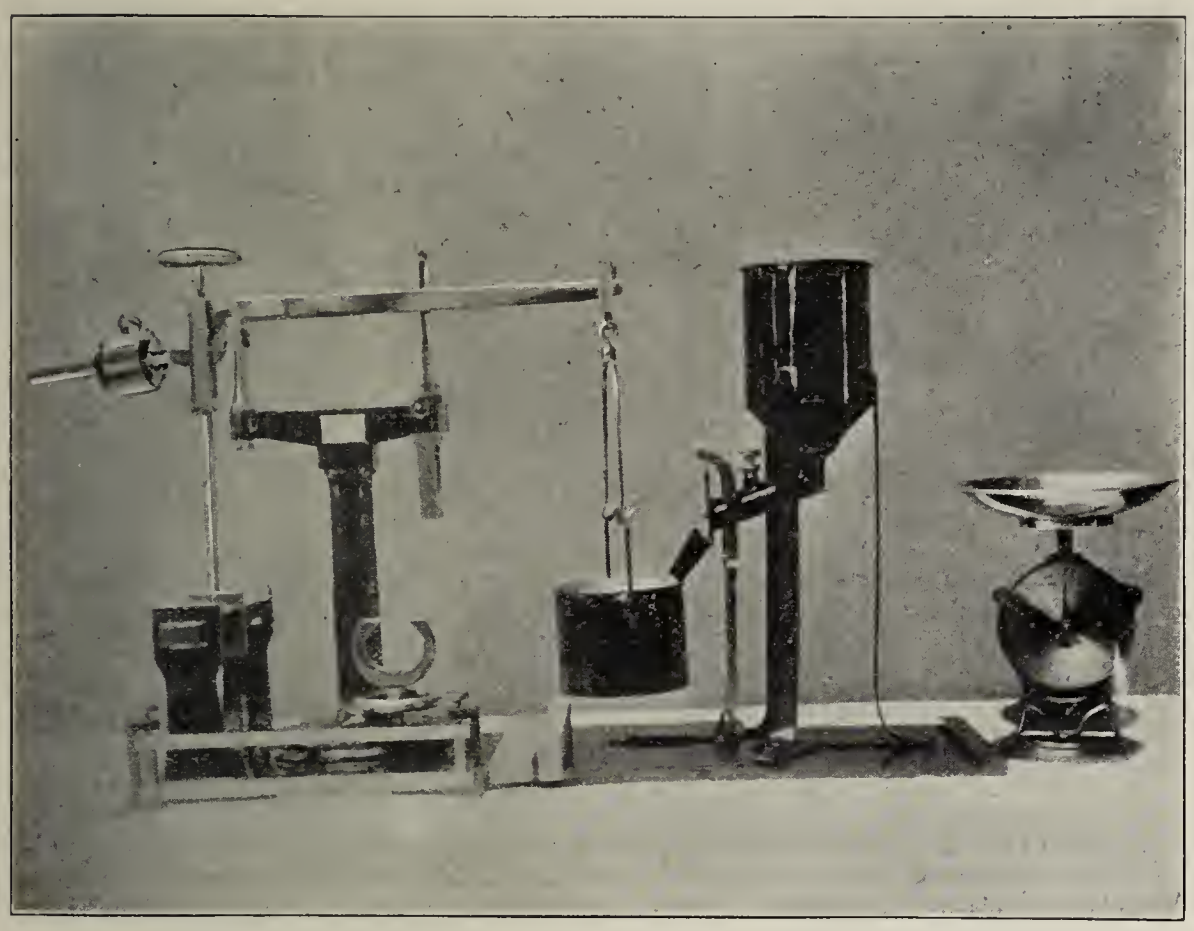

FIG. 3.

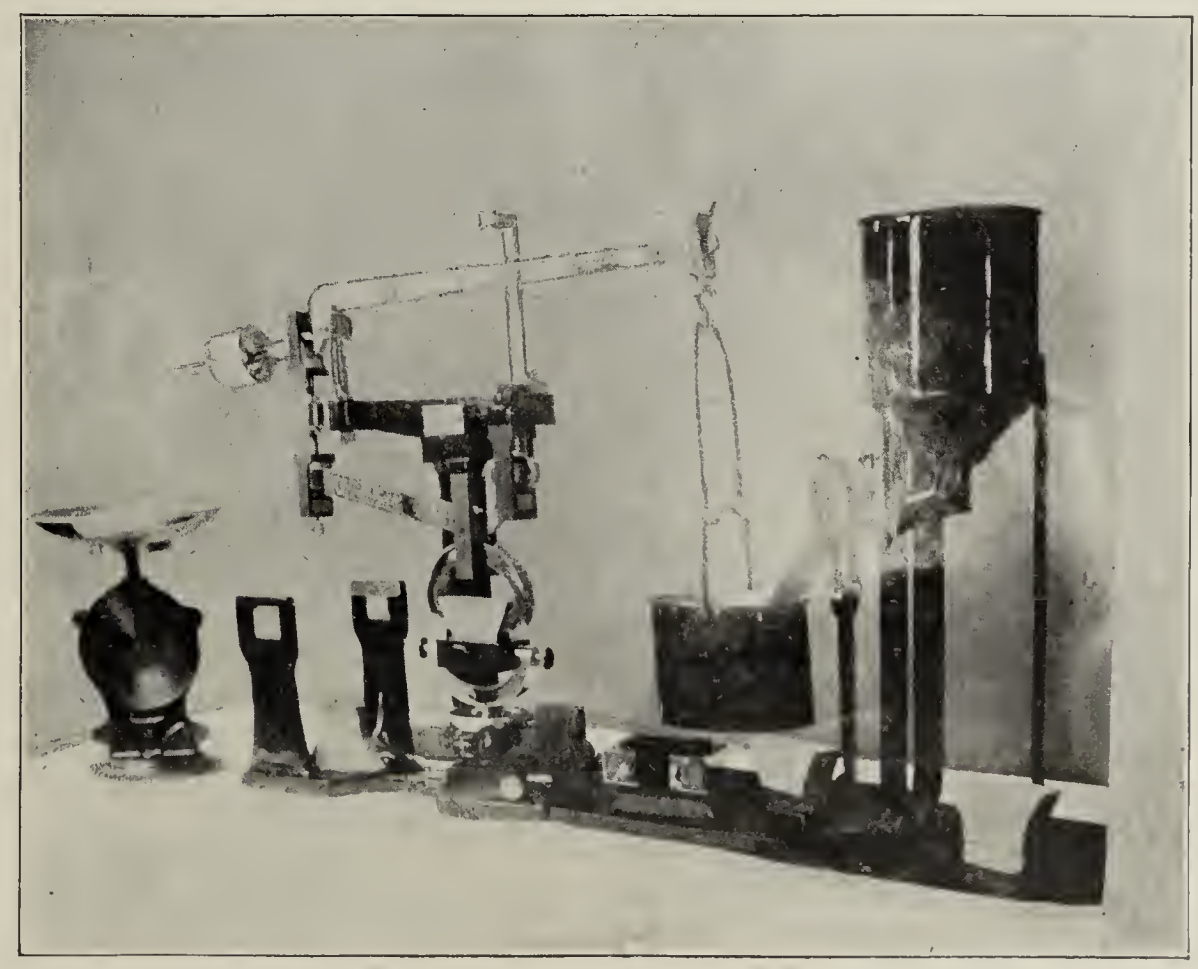

FIG. 4.

Fig. 7

The two adhering bodies then form the test piece, as shown by Fig. 7.

In order to pull the adhering pieces apart the clamps of the tensile strength apparatus are replaced by the clamps *a* and *b* (Fig. 8).

The cement block, the lower part of the test piece, is surrounded by a frame (Fig. 9), which engages the grooves of the cement block and is held by the clamp *a* (Fig. 8), as represented in Fig. 10. Clamp *b* (Fig. 8) holds the upper part of the test piece, which is finally broken like an ordinary tensile strength briquette.

The testing of the adhesive strength of a mortar, one of its most important properties, can be accomplished

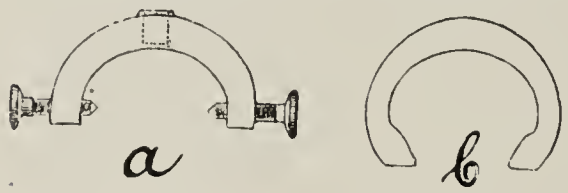

Fig. 8

by the apparatus above described with the greatest accuracy and in the simplest way. By means of this apparatus this difficult task is made possible.

4. RESISTANCE AGAINST PENETRATION.

With hydraulic limes and puzzolana mortars, the progress of the hardening process is usually tested by aid of the Vicat needle or standard needle, which has a sectional area of 1 square millimeter. On account of this small sectional area the weight applied to the needle cannot exceed a few pounds. Moreover, sand mortars or concrete cannot be tested in this way. The following device (Fig. 11) in connection with the tensile strength apparatus enables us to study the hardening process of cements, sand mortars and concrete by driving pins of 1 square centimeter, 0.75 sq. cm., 0.5 sq. cm. or 0.25 sq. cm. into the mortar. The test pieces are made in a brass ring of 8 cm. diameter and 4 cm. height.

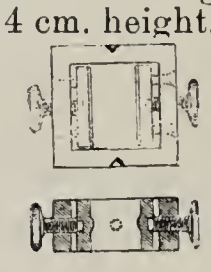

Fig. 9

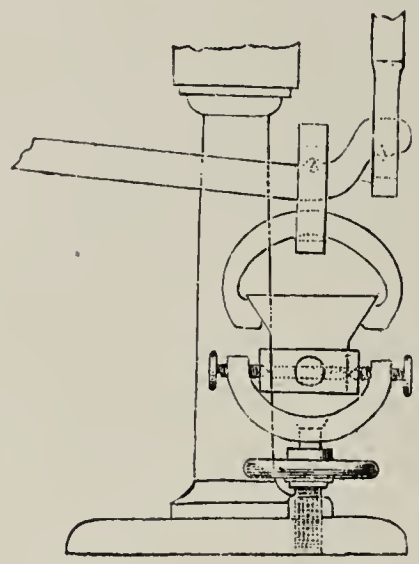

Fig. 10

The test cylinder is placed in the frame, A, and pressed against the steel plate, B; plate H holds it in place. Frame A itself is attached by means of a universal joint to the adjusting screw. The hanging F bears the horseshoe-shaped frame E, closed by the bar C, to which a steel pin is fixed. When the power is applied to the lever system, the hanging F is lifted and the steel pin is driven into the test cylinder from below.

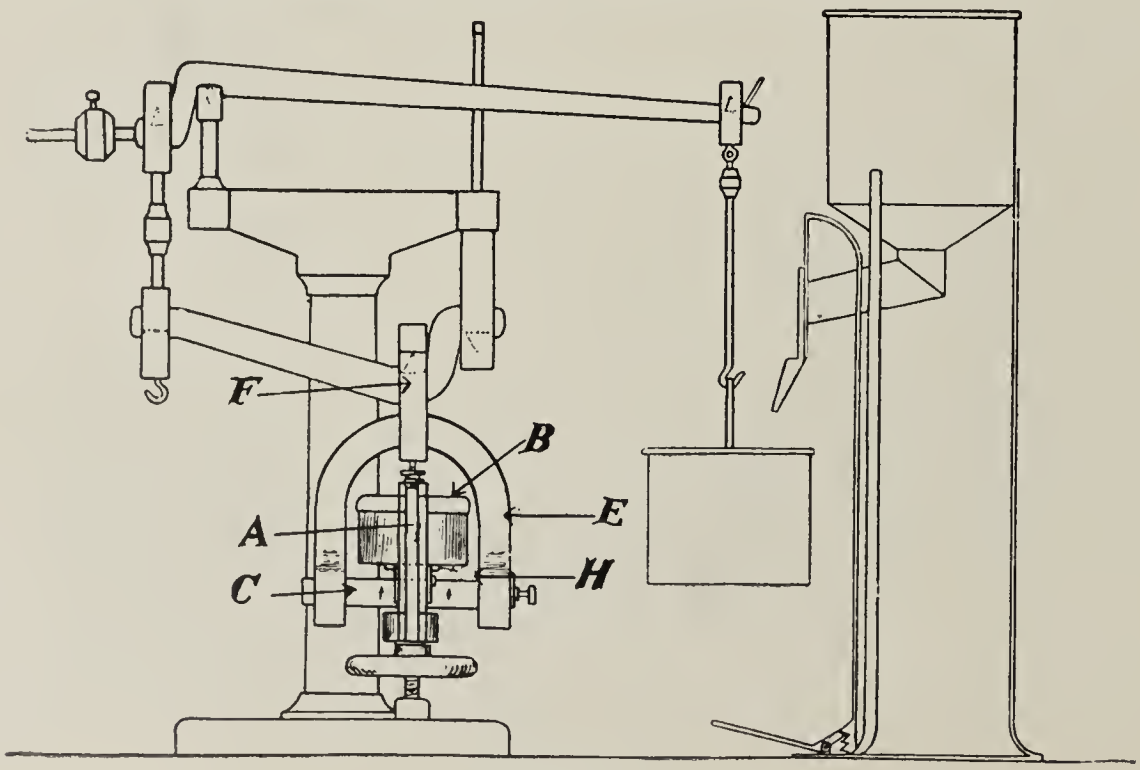

Fig. 11

PAN-AMERICAN EXPOSITION NOTES.

The Postmaster-General has authorized the issue of a new series of postage stamps commemorative of the Pan-American Exposition.

The various states have made provision for exhibits as follows:

New York's appropriation is $300,000. A magnificent permanent building has been erected, and an exhibit which will be highly creditable to the Empire State is being prepared.

Illinois has appropriated $75,000 for a building and exhibit.

Michigan's appropriation for a building and exhibit is $40,000.

Ohio's appropriation is $30,000. The state has erected a handsome building and is preparing an exhibit.

Missouri has appropriated $50,000 for a building and exhibit.

Wisconsin appropriated $25,000 for a building and exhibit.

The New England states have joined together for the erection of a building and display of their resources and industries. Massachusetts appropriated $15,000, Rhode Island $30,000 and Connecticut, Maine, Vermont and New Hampshire are expending sums sufficient for suitable exhibits.

California will make a very extensive exhibit through the State Board of Trade and the Los Angeles Chamber of Commerce.

Alabama proposes to appropriate $25,000 for an exhibit.

Georgia has appropriated a sum sufficient to pay the expenses of a fine exhibit.

Iowa has appointed a commission and an exhibit is being arranged. The Agricultural and Horticultural Boards will participate in the display.

Idaho has appropriated $15,000 for an exhibit.

Pennsylvania's appropriation for representation is $35,000.

Minnesota has appropriated $20,000 for an exhibit.

New Jersey's appropriation for representation is $25,000.

North Dakota will expend its appropriation of $10,000 for an exhibit.

Kentucky has appointed a commission and an exhibit is being arranged.

Oregon will expend $25,000 for an exhibit.

Maryland has appointed a commission to prepare an exhibit and the Baltimore Manufacturers' Association is co-operating.

Delaware has made an appropriation for an exhibit.

Washington, Montana, Mississippi, Louisiana, Texas and other states will be suitably represented.

Send in your subscription for the CEMENT AND ENGINEERING NEWS.

THE CONCRETE QUESTION.

By William E. Smith.

Having had an early and extended experience in the manufacture of artificial stone and concretes, and having seen the very satisfactory results for 30 years, I have often urged upon railway engineers the use of concrete in culverts, tunnels and walls. I have watched with great interest its extended use by the United States government and the railroads of the country and have been especially interested in the reports and discussions recently published in the technical journals. Some scraps from early experiences and later observation may be valuable to those seeking information upon the subject.

My first inspiration and knowledge of the subject was from the published works of Lieut. M. F. Maury, superintendent of the United States Hydrographical office and the National observatory at Washington. From 1844 to 1861 he advocated and urged upon the government the use of concrete in all sea walls, foundations and coast defenses, demonstrating the truth of the contentions by a long series of tests and experiments and investigating the practice and experience in Europe. It was long after his death that his plans and suggestions were adopted by our government engineers, but now all retaining walls in coast defenses and a great variety of other walls are built of concrete alone.

In the difference of opinions and practice I note that, while all agree that first-class Portland cement only sholud be used, the percentage of water, character and quantity of coarse materials and the method and manner of manipulation are as yet open questions.

The most valuable features of Portland cement are that it sets very slowly and affiliates a larger percentage of water in chemical combination than any other known cement. I am prepared to demonstrate in buildings which I erected in Chicago 30 years ago that that chemical action is still going on and the stone growing harder and more dense day by day. The cement and all materials absorbing moisture from the atmosphere continues and extends the chemical action. I have combined Portland and native magnesian limestone cements with excellent results and have never been able to discover any difference in the different classes of work, but in no case were the mixed cements used for surfaces or in moldings, but confined to backing and filling or for underground work.

When extraordinary strength is desired it is a common practice with European engineers to first set the pure cement, then crush and regrind it before final use, the object being to still further retard chemical action.

I note particularly the reports in the February issue of Cement and Engineering News upon the results obtained with so-called wet and dry mixtures, and the difference in weight and strength of the wet over the dry. It will be shown later that the dry mixture therein described would be considered excessively wet to one experienced in the manufacture of ornamental stone, and the excess of weight is due largely to the larger amount of water retained in chemical combination; and in the second case if the tamping had been thoroughly done there would have been no voids and no imperfect bonds.

In both cases the surface evaporation was undoubtedly equal, but in the wet mixture the various constituents were enabled to absorb and assimilate more water. The seasoning was slower, producing a heavier, stronger stone. Had both blocks been submerged in water there would have been much less variation.

A very important point is the uniform setting and seasoning of the whole mass. It should set or dry from the center out, and should be retarded as much as possible. Exposed, as all out-door work is, to the direct rays of the sun or to a high temperature, the surface, if left to itself, will dry too rapidly, materially impairing the strength of the whole. It is due more to this fact than to frost that scaling and cracking of surfaces occur. Assuming, of course, that good, adequate foundations have been put in, a very important requisite is that all evaporation should be replaced and the surfaces kept wet, and, if possible, protected from the sun. Wherever filling of soil is made against a wall the earth will supply moisture, but wherever exposed to the atmosphere it is well to keep the surfaces wet until the mass has begun to dry at the center, if the best results are wanted. Water, and plenty of it, is the most important element in making good concrete.

In making cement stone for ornamental uses, columns, ashlers, water tables, projections, cornices, sills, etc. it is necessary to secure artistic effects with clean, even, uniform colors as well as the greatest possible strength and a surface so smooth and dense as to resist all climatic influences. To secure these conditions the materials must be used only damp, not wet, so that there can be no running over surface or stains absorbed from the wooden molds; simply damp enough to secure slight adhesion by pressing in one's hand. An expert molder will know by the touch when it is just right.

In this work the practice is to use the finest clean, sharp sand, so fine that it will pass through a fine hand or flour sieve. The proper proportions of cement and sand are mixed absolutely dry and sifted together, securing a perfect dry mixture. Each workman uses a common sprinkler pot and uses just as little water as possible to secure a bond under heavy, continuous tamping. This fine mixture is carefully worked to the face of the mold by hand.

The backing or main body of the stone, of cement, coarse sand and gravel (much better than broken stone because less porous) is prepared as follows: The gravel, first wet until it has absorbed all possible moisture, is mixed with dry sand and cement and slightly more water than in the surfacings is added, and then it is thoroughly tamped in layers until the mould is full, but always so dry that no water can be forced to the surface. The surface of each layer is carefully scratched so as to secure a perfect bond. Within a half hour the stone can be turned upon a bottom board and the mold removed, leaving a beautiful, perfect stone. Under no circumstances is the green stone exposed to the sun or a high temperature, nor the surface allowed to dry until placed in the wall. Constant sprinkling is practical until the operator is satisfied that proper chemical action has taken place at the center, when it is gradually allowed to season and dry out.

By this method I have made stone weighing over one ton each with less porosity than is found in any limestone, and second in strength only to the best true granite. I have seen these stone dropped over 50 feet when 20 years old, without breakage, and without marring corners or moldings; and in cutting new stone it was a common occurrence to have smooth, hard gravel cleave under the chisel without disturbing its bond to the mass.

Needing all the water possible, it could not be introduced in mixing without destroying the artistic effects. We added it after the stone was finished, and more uniform results would have been secured were it possible to submerge them wholly in water.

In the use of concrete where only strength and stability is required, the greatest economy is secured by building in movable forms on the ground. This proposition is so well understood as to need no comment. What materials to use, what proportion of each, and how to manipulate them are the open questions. Having good cement one part, two to three parts of clean, sharp, dry sand, a good foundation or wall can be made of old

brick, pottery waste, cinders and many waste materials, but the following materials are, in the order named, the best: Clean iron slag, gravel, crushed granite, broken boulders or country rock and limestone.

Iron slag possesses some elements of Portland cement and is being used in its manufacture. Clean, washed gravel is more dense than any of the other materials and will rob the cement of moisture less than the more porous varieties and is most easily handled. All of these materials should first be thoroughly wet and allowed to absorb all the water they can.

The cement and sand should first be thoroughly mixed dry, then wet, so that it can be handled only in buckets and put into the forms to convenient depth. Next put in the coarse materials and tamp them in so full and thoroughly that the mass will not quake and very little water is forced to the surface. Do not finish the surface of any course smooth, or allow it to dry before adding another, if above the surface, partially imbedded, so much the better, but in any event have the surface raked or roughed up before adding another, and the bond will be all right. Do not allow any surface to dry out during the progress of the work; keep it all wet. The rougher the surface the better, if you propose to plaster or finish the cement, and the sooner the plastering is done the better will be the bond secured; and when once finished keep it all wet until the whole mass has seasoned from the center out.

There are in Chicago a number of large five-story commercial blocks, erected in 1872, with comparatively light walls, built in this way, when a small percentage of gravel was used and 5 to 6 parts of old brick, cinders, plaster and other rubbish, particular pains being taken to have these very porous materials well filled with water before using. These walls are in excellent condition to-day, constantly growing harder, and better than brick masonry of the same thickness and age.

It is not necessary to have all stone broken to uniform sizes, unless there be some economy in handling. Large irregular stone can be used but should not be forced to the surface. No materials put into the trench will fail to be completely surrounded with the binding compound and being already wet cannot absorb the water necessary to complete good chemical action. Thorough tamping will fill all possible voids and the next course will fill up irregular surfaces.

Conditions will vary with every job and will suggest the best method to pursue.

Equally good concrete can be made, either wet, dry or plastic, provided you keep the finished work supplied with all the water it can drink up for at least 20 days after it is finished.

LIQUID AIR.

Scientists connected with the Dominion of Canada department of agriculture have been working upon what promises to be a very interesting discovery, namely, that all objects in nature are covered with a very thin coating of liquid air. It appears, according to this idea, that the walls of houses, the furniture of rooms and the ground over which persons walk are all spread over with a thin film of air in this interesting and highly concentrated state.

The basis of this theory is the fact that any solid has the property of condensing upon its surface gases or the vapors of liquids, such as the water vapor of the atmosphere. If the wall of a room is touched with the finger it encounters, not the wall itself, but a film of gas that covers it. This film is not composed of one gas, however, but of several, the molecules of which have adhered to the surface of the wall.

In addition to the water vapor there are oxygen, nitrogen and carbonic acid gases. Taking them all together they go to make up something which would probably, if one could analyze it, be indistinguishable from liquid air.

These gases, together with more or less water vapor, say the scientists, compose the air of the room. The molecules are darting about in every direction, and as they come in contact with the wall some of them adhere to it. Countless numbers of them together, it is held, form the thin film described. To get rid of the film of liquid air, it is stated, one may employ heat, and, by raising the temperature of the wall the coating of gas may be thinned gradually until it is entirely driven off.

The discovery is claimed by the agricultural scientists to have practical usefulness, and the fact that carbonic acid gas tends to form a coating over every exposed solid is being utilized in experiments now in progress. It is found that a soil which has been deprived of its normal proportion of carbonic acid may be recuperated in this respect by simply turning it over and exposing it to the air, so the needed molecules may settle upon it.

The Alpena Portland Cement Co. started up with 40 men employed, with F. M. Holdeman as general manager. F. K. Potter, sales agent.

CEMENT PIPE LINE.

The Citrus Belt Water Company of Glendora, Los Angeles county, Cal., are receiving bids for the furnishing, ditching and laying of a cement pipe line, about five and one-half miles in length, about one-half mile of which shall be laid with pipes twelve inches in diameter, and the remainder of ten inches in diameter. Specifications can be had by applying to the above, who reserve the right to reject any and all bids. A certified check of 10 per cent will be required to accompany each bid.

U. S. NAVY AT THE PAN-AMERICAN.

The Navy Department is preparing an instructive exhibit for the government building at the Pan-American Exposition at Buffalo. It consists of an 8 by 20 foot map of the world, on which will be designated the principal maritime ports of the world and the United States navy yards and stations at home and abroad. The map will cover the globe, from the sixtieth parallel north to the sixtieth parallel south, and upon it will be placed 307 miniature lead models, each representing a battle ship, cruiser, monitor, gunboat, torpedo boat, submarine boat, sailing vessel, collier or tug of the United States navy in commission, in ordinary, under repairs or under construction. The models of cruising vessels will be painted white, the torpedo boats green, the colliers and sailing vessels black and the tugs and yard boats orange. The largest of the models is not more than one and one-half inches in length. The position of each model upon the map will show the location each day of the corresponding vessel of the navy.

The Pan-American Exposition will use 5,000 electrical horse power transmitted from Niagara Falls.

In machinery hall at the Pan-American Exposition, Buffalo, one of the working exhibits will be operated by a Dodge American System Rope Transmission. Taking its power from a 250 horse power Murray engine the rope will operate a 16 x 16 ft. Roots Rotary Pump with a capacity of 2500 gallons per minute at a speed of 180 revolutions per minute. Intending visitors should make note and be sure to see this.

A prominent Eastern man is now here consulting with the chamber of commerce with a view to locating a Portland cement factory in Tacoma. The gentleman in question is making a casual inspection of three or four Puget Sound cities and will probably decide in a few weeks as to which one he prefers.—*Ledger*, Tacoma, Wash.

THE MARQUETTE CEMENT COMPANY'S LABORATORY BUILDING AT LA SALLE, ILL.

The cement building, constructed upon a wood or metal framework, is distinctly a modern production. As a vehicle for artistic expression cement is eminently satisfactory, either for massive forms or for the light and fanciful treatment of the Elizabethian work.

The cool, grey color natural to it is very restful. The texture is free from the smartness of painted wood and the fussy precision of brick and stone. It is as if the world had become suddenly rich; terraces, balconies, massive walls, deep arcades, classic columns, intricate carving, all may be had for the asking. The imagination of the designer is more likely to run riot than to keep to the path of virtue in which he has been held by the distressing thought that "everything costs too much," when stone, brick and terra cotta are his materials.

The Spaniards, in the early days of America, discovered the value of a flowing covering and applied it to their missions and monasteries with a lavish hand. To-day the crumbling ruins of their buildings are subjects for the artist and the photographing tourist and have served as models for country homes in California, and more recently throughout the Eastern states.

The mild climate of the Pacific Coast gave a sure warrant for the use of ordinary cement as a building material, but in the Eastern states the several variations of temperature and the consequent trial of freezing and melting forbade its use. Now that a high grade of genuine Portland cement has been produced at a reasonable price in the United States, a cement that will bear the strain of a Northern climate without damage, the reason for doubt no longer exists. Cement has come into common use; its value is well known, and it has come to stay.

Coincident with the exhaustion of the supply of pine wood for building the production of cement has grown to huge proportions, and presently we shall see the practice of covering buildings with wood replaced by the use of cement. Wood framing will give way to steel construction, which lends itself perfectly to the combination. The naked steel is gripped by the cement so that the two materials form a cohesive mass, partaking of the strength of the one and the rigidity of the other, far exceeding in absolute value the quality of either, taken by itself.

Two simple conditions must be observed in the use of cement and steel composition. The steel must be clean, and the cement good; the latter honestly mixed and properly treated to insure proper setting. Cement can be, and usually is, tested in important cases, but the reputation and guarantee of a good brand is sufficient, ordinarily, for light work. If not scamped the good results are just as surely to be expected as when brick and wood are employed.

The Marquette Cement Co., whose laboratory is here illustrated, lying cozily on the bluffs of the Illinois river, have the courage of their convictions, for they have not hesitated to use their product on a permanent building.

The first purpose of the laboratory is to afford analyses of the materials composing their cement. Secondarily the house serves as a decent place of entertainment for invited guests, (the hotels immediately accessible being quite ordinary) where a small party may be dined and kept over night if advisable.

The house is incidentally a silent but powerful argument for Marquette cement. It is visible, tangible, and apparently indestructible. It has passed through several severe winters and remains to-day as fresh and untouched as the day it was finished. Architecturally considered, the house is in the Spanish colonial style, from the pencil of Peabody & Beauley, architects, of Chicago, to whom credit for artistic values must be given. The broadly overhanging tile roof affords grateful shadows and a restful atmosphere, which is appreciated to the fullest by the occasional visitor to the "works." The projecting balconies invite repose and suggest the possibility of white-aproned handy-boys and cooling beverages, equally restful on a summer afternoon. As above stated, the building is first of all a laboratory. The dictionary defines the word as meaning "a place to work." It has more of the appearance of a place to escape work.

It is a rather stiff climb from the quarry up to the laboratory and one's natural inclination when it is reached is to find the shadiest corner, and there, in one of the lounging chairs, provided for guests, regard the surrounding country in the full blaze of the summer sun, and thank fortune and the Marquette company for the relief afforded. Gradually, however, curiosity becomes aroused and the question comes as to the construction of the little villa, and the availability of such material for houses of greater pretention.

To such inquiry the host begins by stating that the foundation of the building is of concrete, formed of native stone and cement. The superstructure consists of a wood frame, such as is commonly built up for ordinary dwellings, but having greater thickness in the walls to obtain the requisite depths in openings to secure what the architectural fellows call "artistic effect." The exterior is then covered completely with "expanded metal," another modern development of the use of steel, in which a sheet of thin metal is formed into an open network by piercing and stretching in the machine. This being firmly secured by staples to the woodwork leaves the house ready for its outer skin of cement, which is applied in the ordinary way by the plasterer.

The first coat of cement contains a certain proportion of lime to make it flow properly and form a "key" as it is called. When this is set and "scratched," as the term is, the final coat of clear cement and sand is applied, floated smooth and even, and the work is done. Ornament where used, is first modelled in clay and, a mould being made, is cast in cement and applied on the first or rough coat. The finishing coat being floated up close leaves no possible crack for rain or frost to enter, and being of homogenous nature includes the cast work as a part of its own body, becoming in time one solid mass. The cement does not simply hang upon the steel net work, it coheres with it, so that to separate any part of the steel from the cement requires as much force as to break open a glue joint between two pieces of wood, which generally results in the destruction of the wood rather than of the joint.

As to the interior of the building it is finished quite the same as other houses, with plastered walls and fine woods, and, without going into detail, comprises a spacious dining room in the old Flemish style, with dark oak beams showing in the ceiling, a cavernous fire-place in the end, on which are strewed the trophies of foreign travel in the shapes of steins and antiqe arms. A kitchen adjoins, and, while it is not a laboratory in the sense usually intended, certainly labors and brings forth fruit mete for congratulation on the part of the diners.

On the second story a general lounging room, equipped with a select library, a broad hall for similar use, and a couple of airy chambers, completes the interior arrangement, which serves to render the inside of the house as interesting as the outside.

It might seem as if the "laboratory" exceeded in some degree the purpose for which it was originally built. Certainly the chemist whose lot is cast in this pleasant place has no cause for wishing himself in other quarters. It is the opinion of the writer, however, that the company

has made no mistake. The graceful form, the artistic interior, the evident durability of the building are an object lesson to all who see it. It teaches that a new constructive material and a new method of building has come into the world. People are slow to learn, and the most effective way to teach is by the object lesson. By the expenditure of a few thousand dollars the Marquette Cement company have presented in an unmistakable manner an argument which will, without doubt, affect to no small degree, the volume of their output.

NEW CATALOGUE.

The H. W. Caldwell & Sons Co., Western avenue, 17th to 18th street, Chicago, have just issued catalogue No. 26, 440 pages, cloth bound, illustrating and describing modern elevating, conveying and power transmitting machinery, labor-saving devices and utilities essential in modern mill and factory equipment. One of the specialties produced is the Caldwell Helicoid Flight Conveyor, made of a single strip of metal without lap or rivets, rolled hot, producing a geometrically perfect spiral, which in its cross-section has the thickest portion nearest the shaft for strength, and thinner at the outer edge, thus offering the least possible wearing surface to the material. The entire catalogue will be appreciated by mill and factory interests contemplating increasing their facilities as well as for general repairs. Sent on application, address as above.

HIGH PRAISE FOR THE "CONSTITUTION OF HYDRAULIC CEMENT," BY S. B. & W. B. NEWBERRY.

"No piece of work on the chemistry of cement comparable with this by Messrs. Newberry has appeared within the last ten years, and we congratulate the authors on the sound method, well-directed industry and clear reasoning which are its characteristics."—*The Engineer*, London, Dec. 24, '97.

Copies of this work will be sent to any address on receipt of 25 cents by the CEMENT AND ENGINEERING NEWS.

The entire power transmitting machinery consisting of pulleys, couplings, hangers, collars, and including a mile of shafting from three to nine inches in diameter for the distribution of 2,000 horse power throughout the immense new plant of the Singer Manufacturing Co., South Bend, Ind., now in course of erection will be furnished by the Dodge Manufacturing Co. of Mishawaka, Ind.

The Indiana Cement Co. has joined the Louisville cement combine.

Sioux City, Iowa, will lay several miles of cement walks this season.

The Pioneer Fireproof Construction Co. of Ottawa and Chicago has been sold for $125,000.

J. K. Davis of Wellston, O., is promoting a cement plant to be located near Oreton, Vinton county, Ohio.

The Pulp Plaster Co. of Napoleon, O., are contemplating the erection of Branch Works at Sisterville, W. Va.

Forestville, Chatauqua county, N. Y., has voted for a $7,500 bond issue for the construction of cement walks.

The Monolith Portland Cement Co. of Bristol, Ind., paid out $4,000 for labor and supplies in the construction of its new plant.

La Grange, Ill., near Chicago, will lay 30,000 ft. frontage of cement sidewalk during the season. Petitions filed with the board of improvement call for this amount.

Incorporated: The Lehigh and Northampton Cement Engineering company of Catasaqua, Pa., to construct houses, public works, etc.; capital stock, $100,000.

Articles of incorporation of the Twentieth Century Cement Company of Fenton, capitalized at $750,000, have been received by Secretary of State Warner, Lansing, Mich.

The Salina Cement Plaster Co. has been sold to Senator A. Henley and B. A. Williams. The office of the company will hereafter be at Lawrence instead of Salina, Kansas.

Incorporated: The Venezuelan cement company, "El Crila." Principal office, the Corporation Trust Company Building, Jersey City, N. J. Objects, manufacturing and selling cement of all kinds. Capital, $125,000. Incorporators: K. K. McLaren, John I. Billings, H. S. Gould.

Woodstock, Mich., a station on the Cincinnati & Northern Ry. has been changed to Cement City at the request of The Peniusula Portland Cement Co., whose plant is located at that point.

The Rockland-Rockport Lime Co. of Maine has sold 100,000 bbls. of lime for Massachusetts points. A daily lime train from Rockland, Me. to Boston will be run over the Maine Central Railway.

The Southern Cement Works at North Birmingham, Ala,, started up a part of its plant on March 2 and as soon as the sidings are in the entire plant will be operated. The company manufactures slag cement, using the Vanderbilt Furnace Slag.

Asheville, North Carolina, contains the greatest number of concrete dwelling houses in proportion to the population of any town in the United States. The extensive use of concrete construction on the Vanderbilt estate at Biltmore has educated the people in the vicinity to adopt concrete construction.

American Minister Loomis at Caracas, Venezuela, informs the state department that the controversy between the Warner & Quinlan company of Syracuse, N. Y., and the agents of the New York Bermudez company over the possession and right to work the asphalt deposits at Lake Felicidad, Venezuela, has been transferred to the Venezuelan courts for settlement.

Professor S. W. McCallie, assistant state geologist of Georgia, has discovered that an abundant deposit of marl and phosphates lie in the banks along the Chattahoochee river, near Columbus, Ga. Professor McCallie will also make an investigating trip up the Flint river. These deposits of marl and phosphates are very valuable and property around Columbus has been enhanced by this find.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	JANUARY.				SEVEN MONTHS ENDING JANUARY.			
	1900.		1901.		1900.		1901.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	9,034,600	35,987	375,300	1,468	56,674,869	225,761	59,405,832	230,649
Belgium..	30.237,938	92,546	3,026,870	8,207	172,634,609	515,932	178,234,468	558,899
France	297,600	1,199	432,522	1,697	3,725,745	13,722	10,761,558	38,067
Germany.....	23,549,499	85,935	11,156,657	38,911	299,647,331	1,066,616	240,564,845	864,740
All Other Europe ...	1,885,920	6,087	1,288,820	2,812	16,898,318	54,881	19,486,619	57,114
British North Am...	38,850	281	.....	.....	897,790	5,111	1,203,736	6,387
Other Countries.....	1,401,760	6,848	232,400	872	2,405,260	11,535	5,398,020	22,315
TOTAL	66,446,167	228,883	16,512,569	53,967	552,883,922	1,893,558	515,055,078	1,778,171
Domestic Exports of Cements, bbls.	5,718	11,565	23,844	50,637	40,125	83,450	82,596	184,666

There were 5,586,054 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on January 30, 1900, valued at $18,928, against 9,020,671 lbs., valued at $31,803 in January, 1901.

Imports of asphaltum or bitumen for January, 1900, were 2,096 tons valued at $8,117; January, 1901—6,672 tons valued at $32,064. For seven months ending January, 1900, 63,352 tons valued at $197,094; for seven months ending January, 1901—74,323 tons valued at $262,671.

ARTIFICIAL LIME-SAND STONE.

Stone made from lime and sand is now extensively used for building purposes in Germany. The process of manufacture is substantially as follows: Either hydraulic lime or rich, fat lime after being reduced to a powder by grinding. Ninety-four to ninety-six per cent of this powder is compounded with from 4 to 6 per cent sand by measure. After being slightly moistened the ingredients are thoroughly mixed by machinery and compressed into cast iron molds. These molds and contents are next loaded onto iron cars and run into a large cylindrical steel chamber which is sealed and subjected to a steam pressure of from 120 to 135 lbs. for ten hours. This process completes the handling of the stone. The action of the live steam on the compound is said to render the silica in the sand soluble, which unites with the calcium, forming calcium silicate compounds, depending upon the kind and solubility of sand used.

The erection of a plant in Germany for the manufacture of 12,000 stones per day will cost about $16,000; for one of 25,000 per day, about $22,000.

To manufacture 1,000 stone, 98.4 by 46.6 by 25.6 inches, requires 1 workman, 450 lbs. of lime, 4 to 6 per cent sand, 200 lbs. of coal, and about 10 cents worth of grease and oil.

With the same materials fancy faced stone may be produced. These bring a much higher price; the lime and sand stone in Germany commands a price of from $5 to $9 per thousand, in accordance with the prices paid for clay-brick stone in the districts.

The net cost for 1,000 stone ranges from $2.25 to $3.00.

The essential points of advantage in the manufacture of the artificial lime and sand stone over the clay-brick building stone are:

(1) The cost of production is much lower.

(2) With a smaller investment, considerably more stone can be produced.

(3) The production can take place in all seasons of the year and at all hours.

(4) The stone has a much higher compressive strength—about 550 lbs. per sq. centimeter (0.155 sq. in.)

(5) Colored, face, and fancy stone can be produced.

(6) The stone has a much better and smoother appearance, and there is no loss on account of breakage.

(7) All drying sheds and brick kilns necessary for the production of clay brick are done away with. A space of 65 by 65 ft. is all that is needed for the building of a lime and sand stone factory producing 12,000 stones per day.

In this system granulated blast furnace slag may be used instead of sand. The mode of manufacture is identical with that of the lime and sand stone. Waste of all kinds of sand and of building stones, which contain silic acid, are equally useful and make a good stone.

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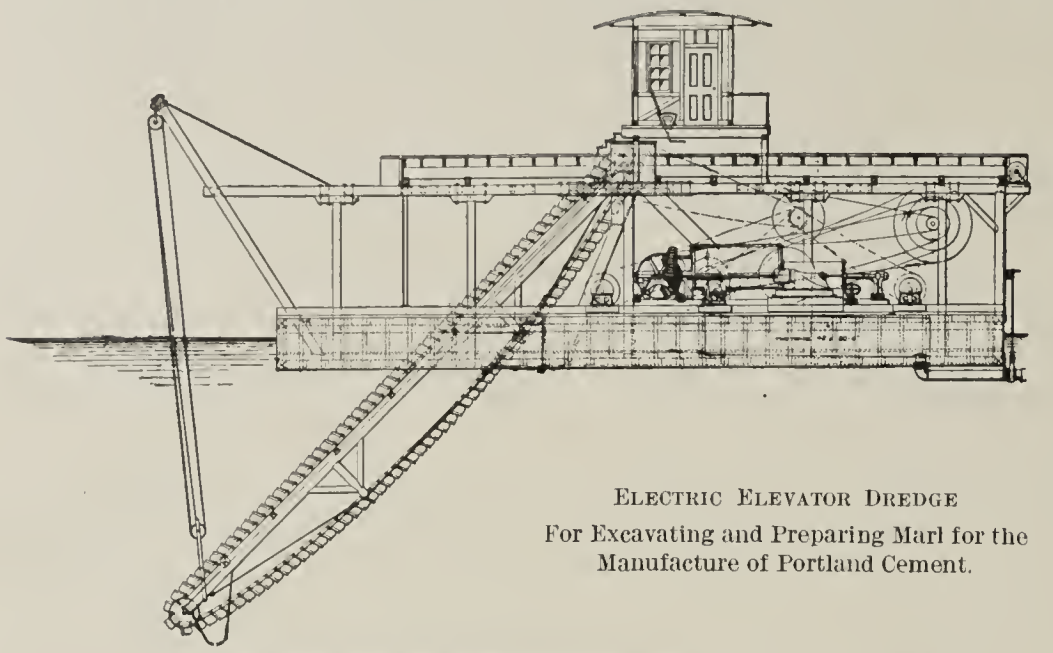

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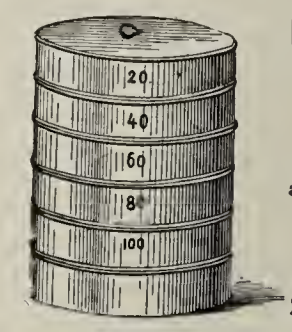

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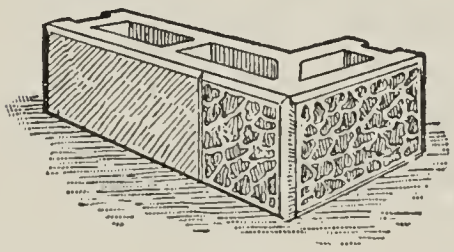

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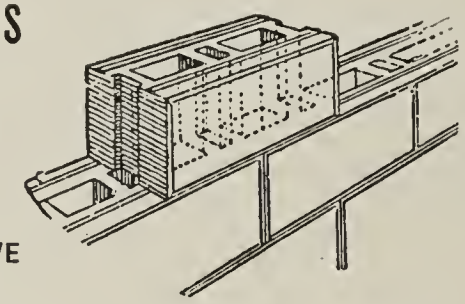

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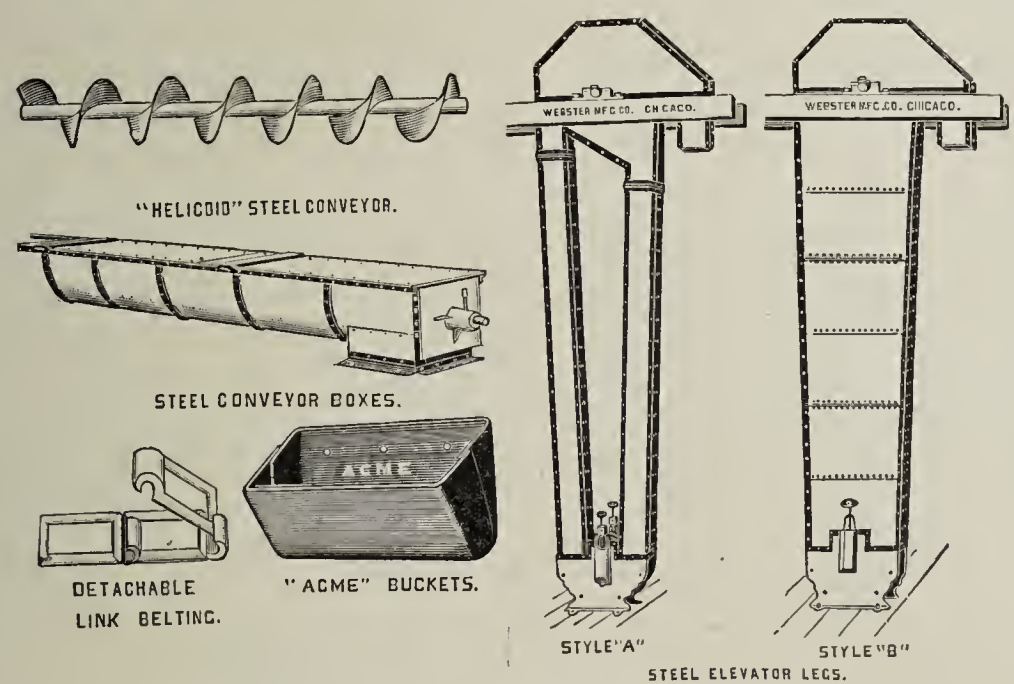

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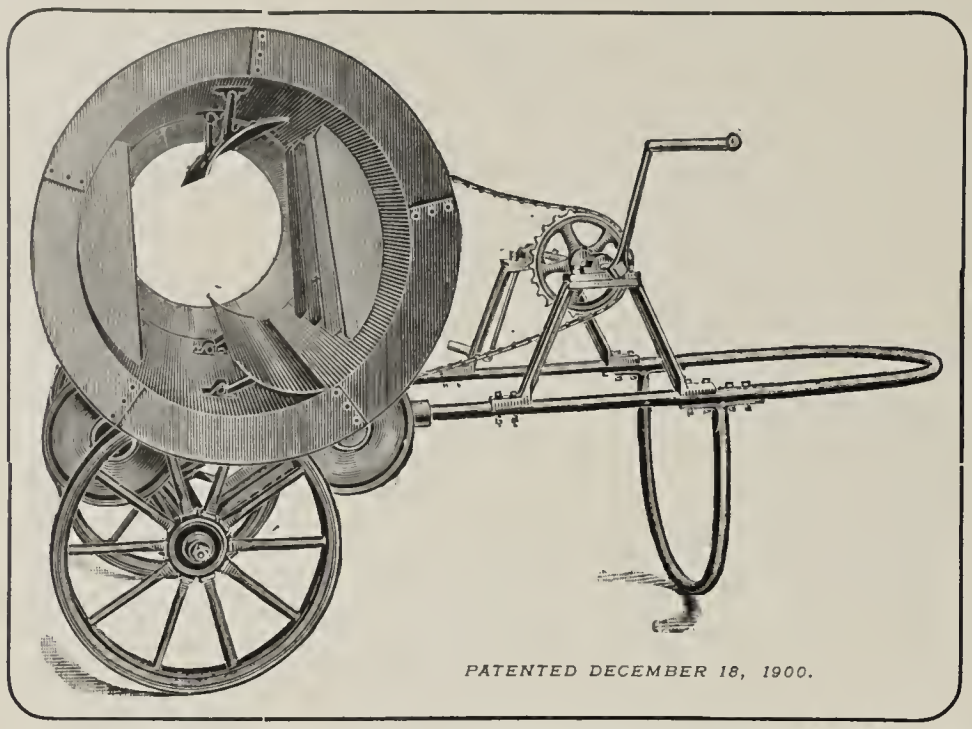

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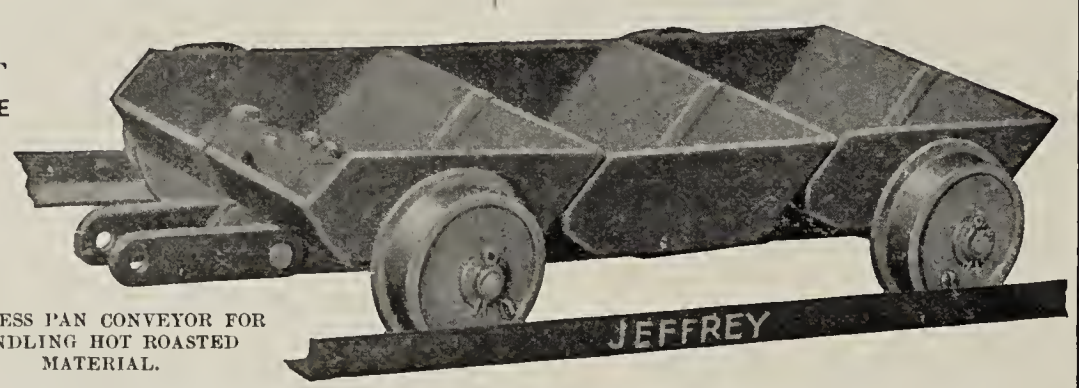

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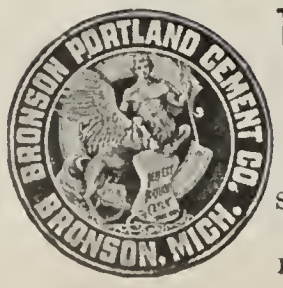

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A. Moore, formerly with the Colorado Portland Cement Co., has started for the Pacific coast to induce capitalists to erect a large Portland cement plant on the coast.

The city of Auburn, Neb., has adopted artificial Portland cement stone for all street crossings. After a thorough test of this material it was found to meet all requirements.

United States Engineer Office, Custom House, Cincinnati, O., April 16, 1901—Sealed proposals for furnishing Portland and natural cements will be received here until 2:30 p. m. standard time, May 16, 1901, and then publicly opened. Information furnished on application. H. F. Hodges, captain engineers.

United States Engineer Office, Custom House, Cincinnati, O., April 2, 1901—Sealed proposals for furnishing at Dam No. 2, Ohio river, about 5,000 barrels cement, Portland or natural, will be received here until 2 p. m., May 8, 1901, and then publicly opened. Information furnished on application to William Martin, resident engineer, Davis Island Dam, Bellevue, Pa., or to Wm. H. Bixby, major engineers, at above office.

United States Engineer Office, Cincinnati, O., April 12, 1901—Sealed proposals for furnishing at Dam No. 13, Ohio river, below Wheeling, W. Va., about 37,000 barrels cement, Portland or natural, will be received here until 2 p. m., May 16, 1901, and then publicly opened. Information furnished on application to William Martin, resident engineer, Davis Island Dam, Bellevue, Pa., or to Wm. H. Bixby, major engineers, at above office.

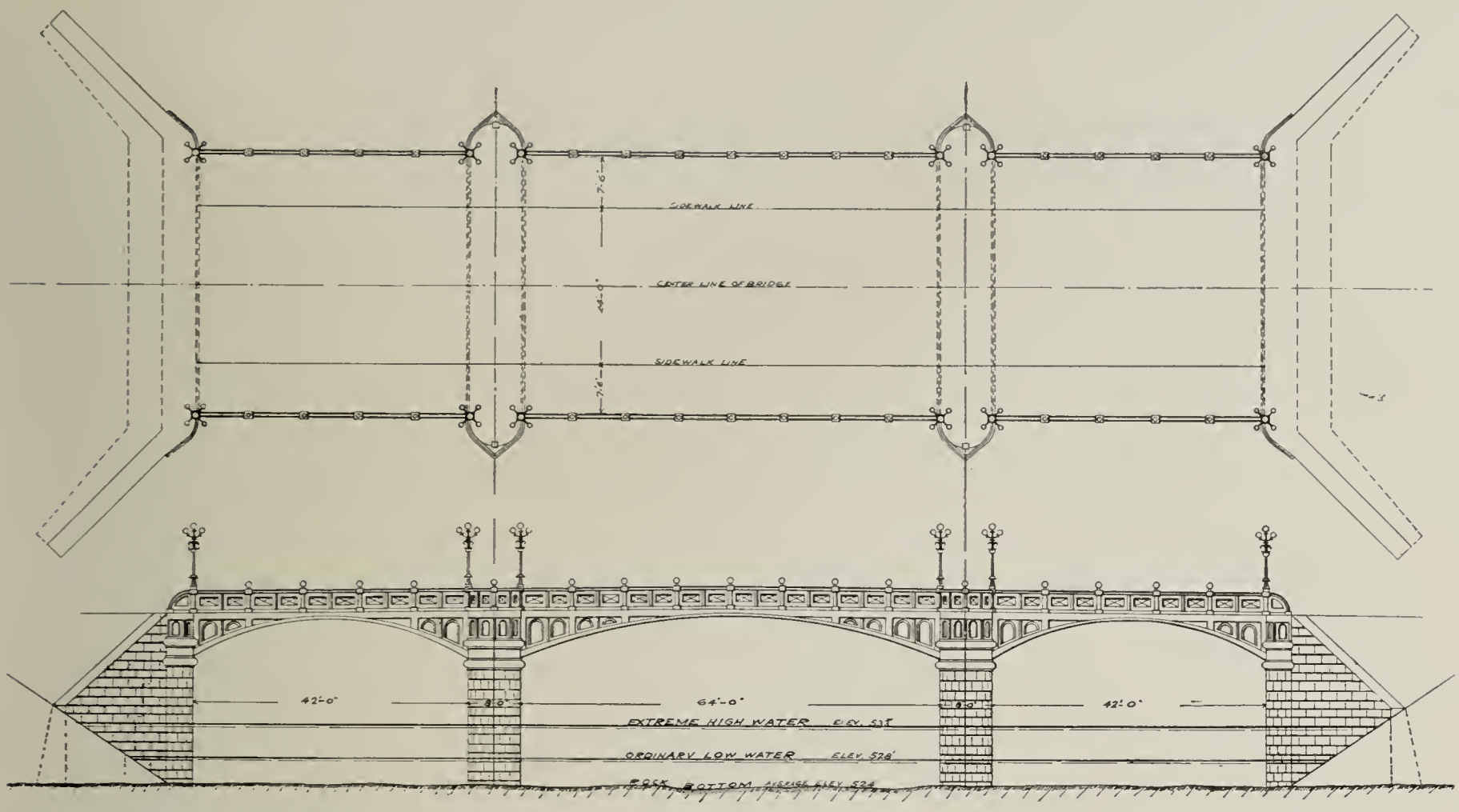
IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	FEBRUARY.				EIGHT MONTHS ENDING FEBRUARY.			
	1900.		1901.		1900.		1901.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	4,727,200	17,275	.....	.....	61,402,067	243,036	59,405,832	230,649
Belgium..	9,190,076	27,000	3,091,598	8,574	181,824,685	542,932	181,326,266	567,473
France	297,600	1,199	416,600	1,787	4,023,345	14,921	11,178,158	39,854
Germany.....	19,831,187	70,187	5,501,460	26,590	319,528,520	1,136,803	246,066,305	891,330
All Other Europe ...	397,400	1,427	.....	.....	17,295,718	56,308	19,486,619	57,114
British North Am...	.....	..... .	52,910	214	897,790	5,111	1,256,646	6,609
Other Countries.....	243,600	1,127	.....	.....	2,598,860	12,662	5,397,820	22,315
TOTAL	34,687,063	118,215	9,062,568	37,165	587,570,985	2,011,773	524,117,646	1,815,344
Domestic Exports of Cements, bbls.	7,737	14,902	11,848	25,617	47,862	98,352	94,444	210,283

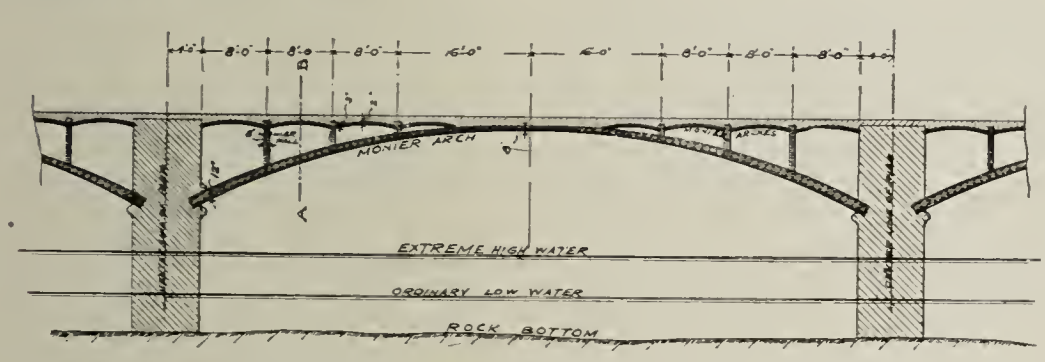
There were 6,108,949 lbs. of imported Roman and Portland cements, etc., in the United States bonded ware houses on February 28, 1900, valued at $18,826, against 9,425,610 lbs., valued at $32,912 in February, 1901.

Imports of asphaltum or bitumen for February, 1900, were 5,182 tons valued at $12,116; February, 1901—7,447 tons valued at $43,695. For eight months ending February, 1900, 68,534 tons valued at $209,210; for eight months ending February, 1901—82,772 tons valued at $306,392.

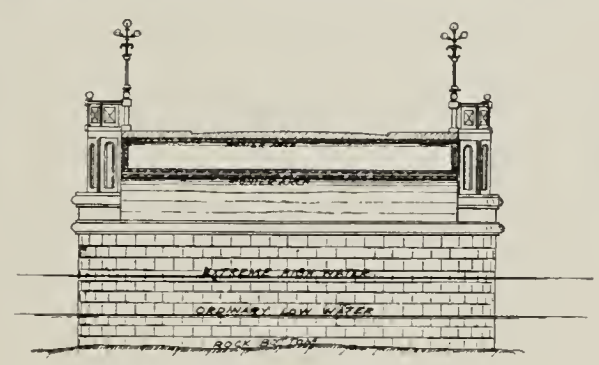
PROPOSED MONIER BRIDGE ACROSS NIAGARA RIVER BETWEEN GREEN AND GOAT ISLANDS.



A. J. WENNERBALD, Engineer. E. LEE HEIDENREICH, Consulting Engineer.



LONGITUDINAL SECTION OF PART OF BRIDGE



CROSS SECTION OF BRIDGE
SECTION 'A-B'

The design shown in the accompanying cuts was submitted by Mr. E. Lee Heidenreich, contracting engineer of Chicago, and sole representative for Monier constructions in the United States. The cut only shows two spans of the bridge while the proposition included three more spans. The design is decidedly unique, but since it was submitted we find that a similar design has just been accepted over the river at Chatellerault, France, and submitted by Mr. Hennebique. Owing to the peculiar disposition of the live load by supporting the same on cross walls forming panels, the calculations of the bridge by analythical or graphostatic methods becomes more simple, and as a result extremely light dimensions have been reached while still retaining ample safety, and this in connection with the neat appearance of the design particularly recommends the construction.

Plans were completed recently for a new cement plant at Stewartville. N. J. A. H. Bigelow is the promoter of the present scheme.

Work on the Central Market street electric railway now under construction at Columbus, Ohio, was stopped owing to the company's using crushed stone for its roadbed where the city ordinances call for concrete.

Adolph Grant & Co. of Philadelphia, have closed a contract for the marble, tile and mosaic work for the Mount Sinai Hospital, which is to be built at One-hundred-and-first street and Fifth avenue, New York. Over 400,000 feet of floor and wall space is to be covered with marble and tile, and it is said to be the largest operation of its kind ever given out in the United States.

The Supreme Court of Michigan has affirmed the decision of the lower court of Kent county, Mich., declaring the Barber Asphalt Co.'s plant at Detroit a public nuisance and injurious to the property in the vicinity as well as the health of the residents of the neighborhood. The court entered an order restraining the business unless the injurious effects upon the complainants and their families can be abated.

The Marshalltown Stone Co., Marshalltown, Iowa, has contracted to furnish 150,000 cubic yards of crushed stone to the Chicago & Great Western railway. An additional stone crushing plant will be installed to enable the company to get the material out on time.

The Hecla Portland Cement Co. of Detroit, Mich., is the name of a new company organized recently under the laws of West Virginia, with a capital of $5,000,000. The incorporators are: Cameron Currie, Julius Stroh, Edward H. Parker, H. H. Hatch, all of Detroit, and Waldo R. Lorenzo of Bay City.

The companies operating the stucco mills at Fort Dodge, Iowa, have been requested to give options on their plants to eastern parties in order to form a combine in which Standard Oil capital is to be largely interested to purchase all the mills in the country. It is reported that the Grand Rapids, Mich., stucco mills have already given options. The general offices of the combine is to be located at Chicago.

THE TECHNOLOGY OF CEMENT PLASTER.

By Paul Wilkinson, St. Joseph, Mo.

HISTORY.

From the earliest times, the principal component of wall plaster has been ordinary lime. Plaster of paris has also been known from early times, but never used to any extent in the actual base-work of plastering materials; it is generally used for finishing over the brown coat and for ornamental work. As an illustration of the antiquity of the use of gypsum plaster for mortar, I find that the analysis of the exterior covering of the pyramid of Cheops, as made by Dr. Wallace, is almost identical with that of our best cement plaster. The analysis is given in the *American Encyclopædia* as follows:

Hydrated calcium sulphate	82.89
Carbonate of lime	9.80
Magnesia	0.79
Silicic acid	4.30
Alumina	3.00
Oxide of iron	0.21
Total	100.99

For the last quarter century, however, plaster of paris has been the chief constituent of numerous patent plasters, or "hard plasters," as they are sometimes called. The formulæ of these all vary but slightly. In addition to plaster of paris, we find in the records of the Patent Office the following substances used to perfect the working qualities of these materials, or to give them some peculiarity for the purpose of advertising, viz.: slaked lime, sawdust, asbestos and various qualities of clay, together with some form of retarder to restrain the setting action of the plaster of paris for such a time as will give the mechanic opportunity to apply the mortar nicely.

As early as 1871 gypsum rock had been found and manufactured in Kansas. Later, a workman from one of these plaster of paris mills, which were then all located at Blue Rapids, in the eastern part of the state, happened to be stopping at the farmhouse of Mr. Jonathan Tinkler, 1¾ miles northeast of the present town of Gypsum City, Kan., and his attention was called to some plaster which Mr. Tinkler had made for plastering the cellar of his house, by calcining in an ordinary 30-gallon kettle some of the so-called dirt from one of his fields. The plaster is still there and in good condition. Mr. Tinkler discovered this earthly deposit while running a "fire-guard" around the field; he did not manufacture the material, however, until 1875. The above mentioned workman told Mr. Tinkler of the importance of his deposit; and in 1889 the latter interested some local capitalists, a small company was formed, and a discarded plaster of paris mill from a nearby town was purchased and moved to Gypsum City, where it was set up for the treatment of this earth, the crude material being hauled in wagons from the farm to the mill in town. This original company in this field was known as the Saline county Plaster Co.; the deposit being located in Saline county, Kansas.

In casting about for a proper name for this material, which, by the way, when manufactured, resembles a Portland cement, the manufacturers finally decided upon the name "cement plaster." I believe their idea was chiefly to obtain the advantage of whichever freight rate, that on cement, or that on plaster, should be the lower, as well as to provide for the possibility that the material should prove a successful cement. This name, cement plaster, was afterwards applied by the plaster of paris companies to their wall plaster products, but rightfully belongs to only those wall plasters which are manufactured from this earthly material.

During a recent conversation, my friend, Dr. E. H. S. Bailey, Professor of Chemistry in the State University at Lawrence, Kan., suggested that we call this material "gypsite," so that it might have a distinctive name. I think this suggestion a good one; have endeavored to introduce this name in the industry, to denote this gypsum dirt; and will so use it throughout this paper.

In 1890, the Saline County Plaster Co. sold out to a company organized by larger capitalists, and called the Acme Cement Plaster Co., which has been in successful operation ever since. After the Acme company had developed a successful industry from this deposit, others began to investigate, and other companies were formed. It was thought for a time that the Gypsum City deposit was the only one in existence, and practically inexhaustible. It covered an area of 12 acres with an average thickness of 8 feet, and more than 100,000 tons were manufactured from it before it was abandoned. The original members of the Saline County Plaster Co., after they had sold out to the Acme company, prospected in the "Pan-Handle" of Texas, discovered a large and valuable deposit there, and formed the Lone Star Plaster Co., operating at Quanah, Tex. This was absorbed by the Acme company a few years later. The deposit, covering in all about 6,000 acres, is certainly one of the most remarkable ever discovered, by reason of its vast extent and the character of its material, and the Acme cement plaster manufactured here is shipped to all parts of the United States, and even to Canada. An experimental shipment has just been made to Australia and New Zealand.

The field is now covered by several companies, manufacturing as follows: The Salina Cement Plaster Co., at Dillon, Kan., 14 miles east of Gypsum City; the Dillon Cement Plaster Co., 3½ miles southwest of Dillon. The Acme company has another mill 3 miles beyond the last mentioned. The Salina company also has a second mill, at Longford, in Clay county, Kan., 35 miles northwest of the Dillon mill. The Acme company has its principal mill 5 miles northwest of Quanah, Tex., which town is 192 miles northwest of Fort Worth. In this vicinity there are a few temporary mills experimenting, and there are also a few mills in the Indian Territory, the only one of any importance being that of the Royal Cement Plaster Co., at Marlow. There are at present eleven mills in Kansas engaged in the manufacture of plaster; four use the gypsite and seven the gypsum rock.

Indications all point to the final location to the whole of this industry in the "Pan-Handle" of Texas, for the reason that the Kansas and Indian Territory beds are comparatively limited, whereas the deposits seem to exist in inexhaustible quantities in the "Pan-Handle."

GENERAL CONDITIONS.

This paper is intended to deal exclusively with the technology of the cement-plasters. As I understand, the geology of the subject has been and will be treated by others. Hence I will not discuss the character of these deposits, beyond observing that there is a great diversity of opinion as to their origin. The most plausible theory seems to be that of their precipitation from springs, aided by wash from adjacent territory.

The composition of the crude material, as well as its manner of deposit and its proximity to railroads, are all points to be considered by the manufacturer. *Per se*, these industries do not warrant at the present time the construction of independent lines of railroad. Many of the deposits lie in low, swampy ground, and gypsum springs usually occur in them. In most cases there is a ledge of gypsum rock at the bottom of the deposit, but sometimes even lower, and sometimes not immediately under, but on the same level, at some distance from the gypsite deposit. The deposit of the Acme company in Texas has an average depth of 30 feet, and immediately under this is a heavy bed of excellent gypsum rock, which is used by the company for the manufacture of plaster of paris. Many deposits have been found which are entirely worthless for one or both

of two reasons: because of the percentage of sand and clay, where the above mentioned side wash is excessive; or because the material occurs in too small pockets. This material being worked by plow and scraper, too much labor is required to operate small pockets properly. In these sections the water of all the streams and wells is highly impregnated with magnesium sulphate, which does not seem to affect animals, but has the usual effect upon man. In most instances, however, the workmen become habituated to the use of this extremely mineral water.

TECHNOLOGY.

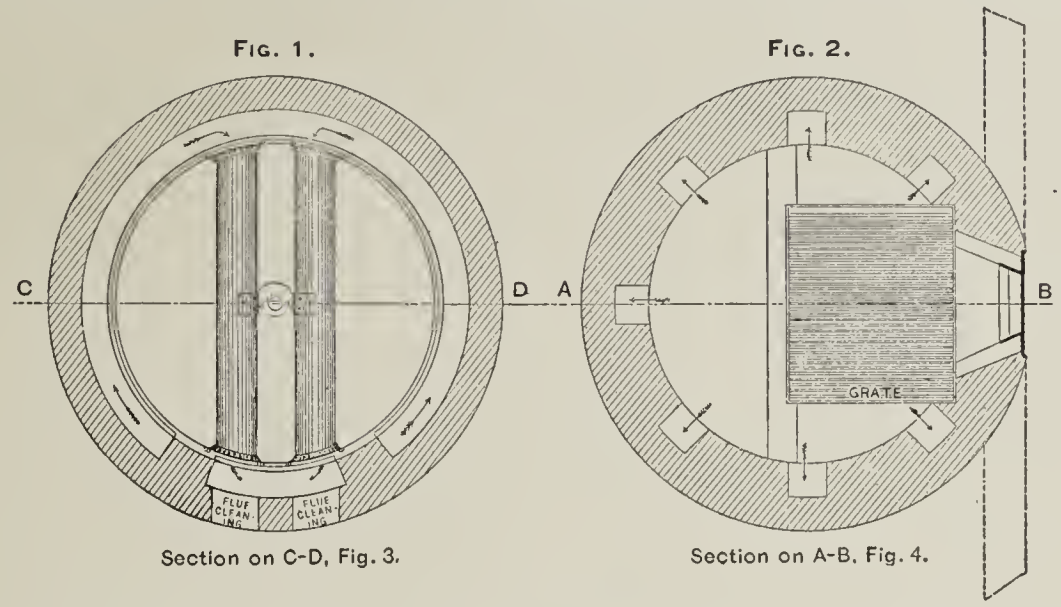
In considering the technology of gypsite it is necessary to consider the composition of the material in comparison with that of gypsum rock, in order to understand the difference in the manufacturing processes of plaster of paris and cement plaster. It is the foreign ingredients in the gypsite which cause the difference. The analysis of a sample of first-class gypsite is as follows:

	Crude.	Manfd.
Insoluble residue	.91	2.53
Iron and aluminum oxides	.21	.45
Calcium sulphate	69.92	78.81
Calcium carbonate	9.05	11.22
Magnesium carbonate	.65	.74
Water	18.85	5.70
Total	99.59	99.45

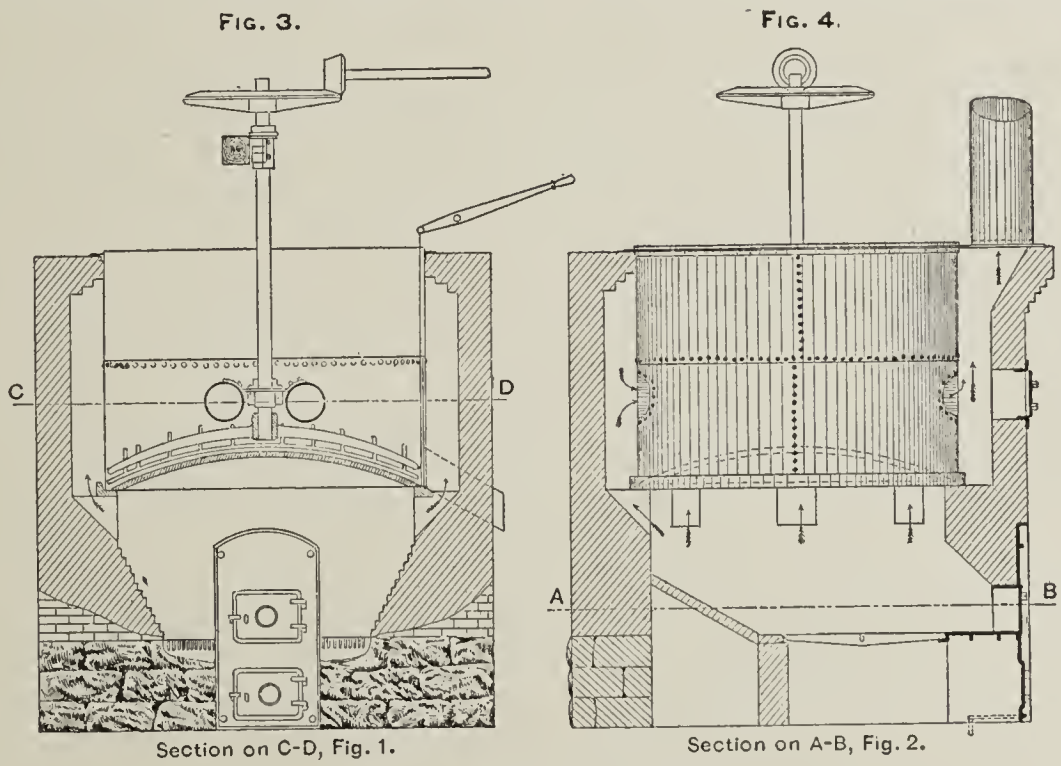
Gypsum rock, as is well known, occurs in ledges; is mined and transported to the factory; and is there reduced by nippers and Gates crushers to the size of small marbles. It is then run through buhrs and finely ground, and conveyed by elevators to bins over the calcining-kettles. From this stage, the process is practically identical with the manufacture of gypsite into cement plaster. Gypsite occurs in pockets of greater or less extent on the surface of the earth, with from a few inches to 2 or 3 feet of surface loam on top. It resembles marl in appearance, and is in a fine state of subdivision. It is usually more or less moist, on account of the fact that the pockets occur in marshy meadow lands along the sides of a stream. In mining it, the surface covering is stripped off and scraped to some distance outside the deposit. It is most advantageously manufactured during the hot season of the year, as at that time manufacturers obtain the assistance of nature in drying out the physically combined moisture. It is a peculiarity of gypsite that it absorbs and holds water with great avidity, and freezes readily, so that in securing stock for winter purposes it is necessary to have large storage sheds and fill them during the drier months of the year; hence the scene of greatest activity is during the months of July, August and September, when the manufacturers endeavor to fill their sheds with dry material, and at the same time are being "rushed" by the large demands for their product, as the building season is then at its height. The material is frequently piled in various portions of the bed to mix the various strata thoroughly, as well as to permit the moisture to drain out. I have seen these heaps frozen to the depth of 2 or 3 feet, in weather when ordinary soil would not be frozen.

Manufacturing plants, when possible, are located on the gypsite bed itself, or adjacent thereto, so that the expense of the transportation of the raw material may be reduced to a minimum. No matter what the distance from the railroad, it is cheaper to transport coal from the railroad to the mill as a back haul and to haul the manufactured material, than it would be to haul the crude, wet material from the bed to the railroad and manufacture there. This has been illustrated in the experience of the Acme company, which hauled its crude material $1\frac{3}{4}$ miles to its mill at Gypsum City, whereas its other Kansas plant is about 7 miles from the railroad, and loads of two or three tons are hauled on broad-tired wagons to the shipping station, the hauling contractor making a very favorable rate on coal and supplies for a back haul.

The material is loosened in the deposit by means of disk harrows and then taken into the stock warehouse by means of wheeled scrapers. There are some irregularities in every deposit; and the principal object sought by the manufacturer is to mix the materials thoroughly, so as to procure a uniform output. After the material has been put in the warehouse it is at the same stage as the plaster of paris, when the latter has reached the bins, as above described.



The principal and really exact process is that of calcination. For this purpose boiler-iron kettles (see Figs 1 to 4) of $\frac{5}{8}$ inch thickness, 8-feet diameter and 6-feet depth are used. The foundation for a kettle is necessarily built very solid, the fire-space within the foundation being in the shape of an inverted truncated cone 4 feet high. At the top of this a cast-iron flanged ring is set into the masonry. The kettle-bottom consisting of a concavo-convex iron casting, a little less than 8 feet in diameter, with convexity placed upward with a rise of 1 foot, and with a thickness of $\frac{3}{4}$ inch at the edges and of 4 inches at the crown, is set within the flange at



SECTIONS OF CALCINING KETTLE.

the top of this ring. The kettle proper is then placed over the kettle-bottom. This kettle has two flues 12 inches in diameter, placed transversely about 8 inches above the crown of the kettle-bottom, and separated externally about 6 inches. After the kettle has been set, brick masonry is erected around it, gradually converging at the top to meet the top rim of the kettle. The first floor of each mill is usually built around the kettle about a foot from the top, sometimes level with the top, to facilitate the shoveling of dirt directly into the kettle by hand; and the kettle, with the furnace, is in the basement, with storage room for fuel conveniently arranged in front of the kettle. Ports are made through the side of the base ring; and the heat from the furnace is deflected by bridges around the surface of the kettle, so that it may cover every part of the kettle, pass through the flues, and finally make exit through a regular stack. For fuel, the best of coal must be used, having a minimum of sulphur, coking freely and giving a long flame. The best coal is procured in the Trinidad district of Colorado. Kettle-bottoms of sheet steel have been tried, but do not serve as well as cast iron ones. Only the best scrap iron must be used in these kettle-bottoms, it having been found that ordinary scrap iron does not last nearly so long as pig. The life of a kettle-bottom is terminated by cracking. The cracks can be caulked with asbestos cement, but the expense of repairing and stoppage soon overcomes the saving. At the top the kettle is covered with a sheet iron cap with a movable door, through which the material is introduced, usually by a chute, fed by an elevator from the dirt pit. The usual number of kettles is four to six. They are arranged in line and usually worked in pairs. It is necessary that the material in the kettle be constantly agitated; and for this purpose a line-shaft is run over the kettles and a vertical shaft runs from this to the bottom of each kettle, being supported below by a saddle placed between the flues. At the bottom of the shaft a curved cross is attached, to which are affixed movable teeth with paddles, which are so adjusted as to throw the material from the periphery to the center. Should the agitation stop, or the teeth become broken, the material settles down on the bottom, and, owing to the intense heat, the bottom is almost instantly melted through. The material when heated is very fluid, runs through like water and quenches the fire. The Acme company had in one instance a heavy loss in the death of a fireman who was slashing the fires at the time when a kettle-bottom burned through. The material ran down, was deflected from the fire, and the fireman was instantly enveloped and burned to death. The stoppage of the agitation can usually be detected by the calciner, who stands above and is supposed to watch the process of calcination constantly; but in this instance the calciner had stepped aside for a moment, and it was all over when he returned.

Both water power and steam power are used for driving the machinery. When steam is used, the slack from the fuel used under the kettles is employed for the boilers.

Upon the correct calcination, more than anything else, depends the quality of the material. The calcium sulphate in gypsite is hydrated, as it is in gypsum rock. The object sought is to drive off a portion of this water of crystallization. To attain this end, in the plaster of paris manufacture, the temperature does not exceed 340° F.; but in the manufacture of gypsite, probably on account of the foreign matters, a higher temperature is required, which averages close to 396° F. In starting a kettle, heat is gradually applied, and the crude material is gradually fed in and constantly agitated. This process is slow, and requires some length of time, on account of the vast amount of physically-combined moisture to be evaporated. Material is gradually added until the kettle is full, and during this process the contents of the latter boil in a violent manner closely resembling the boiling of water. The fact that the physically-combined moisture is all evaporated is indicated by the prompt settling of the material; the heat then rises to a higher degree and ebullition again takes place, indicating the driving-off of the water of crystallization. The point at which the process is complete is known by the manner in which the material boils and by its general appearance; and the calciner, at the proper moment, lets off the charge through a small gate at the bottom and in the side of the kettle. Thermometers are used in plaster of paris manufactories to govern the temperature exactly; but in the gypsite manufactories the point varies slightly and is usually best known by an experienced calciner. The escaping steam is let off by means of a stack let into the sheet iron cover of the kettle parallel with the smokestack, and this stack contains near its base a separator similar to the steam-separators, for the purpose of retaining the plaster dust. It has been found by raising the iron cover about 18 inches and putting on proper sides, that it furnishes a chamber above the boiling material and greatly assits the escape of the steam from it.

From the kettle the hot material runs like water into a fireproof pit. The kettles are usually run in couples so that one pit will do for two kettles; and one chute will do for two kettles in filling; as the kettles are run at slightly different periods. Each kettle contains a charge of about five tons of manufactured material, and requires about three hours to calcine properly. After cooling slightly, the manufactured material is elevated into a revolving screen, which separates all small particles and foreign matter, and renders the product uniform. The screenings run from ½ to 1 per cent only. It is usual to have a series of screw-conveyors and elevators both in front of and behind the screen, so as to mix the material thoroughly. Owing to the temperature of the material, all conveyors, elevators and interior linings must be of metal, and the screen is made of wire-cloth. From the screen, the material is conveyed to the storage bins, which are usually arranged to hold 100 or 200 tons, and of which there are several, so as to separate, if desired, the runs of different days. The material is usually allowed to fall from a screw at the top of the building, first, that it may spread out and let the different portions mix thoroughly, and, secondly, that it may cool in passing through the air.

Various elevating devices have been experimented with, among them the blower. It was proposed to use this for the purpose of elevating the hot material from the kettle-pit to the bins, as it was hoped by this means to render unnecessary a screen and expensive bucket elevators, and would also cool the material. This method was tried at one of the plants, but was soon abandoned, as I infer, on account of the clogging of the material, which owing to the fineness of the manufactured article, diffuses through the atmosphere, soon fills up all open parts of machinery, and renders efficient lubrication extremely difficult. The friction in certain parts is heavy, and the bearings must be watched carefully.

Owing to the peculiar characteristics and constituents of different deposits, the setting-time of the manufactured article is apt to vary greatly. The most suitable time for working the material is about one hour, when it is mixed with sand. This gives the plasterer time to apply the mortar properly, and after that time, the material commences to harden, so as to render further tempering impossible. Manufacturers whose material does not reach this standard, usually have to "retard" their material. For this purpose there are numberless inventions. Some of these retarders are added to the material just before

it leaves the kettle, so as to have the advantage of the thorough mixing which it receives in its course to the bins. Others are applied just before the material goes into the storage-bins; and some, after it has been taken from the storage-bins and just before it is sacked. Some manufacturers add hair or fiber, as desired by the customer. The material is then sacked directly from the mixer.

The final process in the production of this material is the packing. Barrels are seldom used, the principal containers being jute sacks, which contain 100 pounds net. These sacks are made of the best jute and will stand considerable wear and tear in transportation. They are sold to the consumer, and he is allowed a credit of the same amount as he paid for them, on returning them to the mill. Thus the manufacturer is enabled to keep the burden of the package on the consumers. Paper sacks are also used, as in the hydraulic cement industry. These contain but 75 or 80 pounds of cement plaster, however, as the material is extremely light and fluffy. These sacks are not desirable, as for some reason, when filled with cement plaster, they break and tear much more easily than with hydraulic cement.

REMARKS.

In conclusion I would observe that the fuel question is the one above all else demanding attention. Owing to the simple arrangement of the kettles but a small amount of the heat is utilized; and by some arrangement for dryers arranged over the kettles the crude material could be made to absorb and utilize a good amount of this waste. Various plans have been proposed, but none of the manufacturers have as yet felt the necessity of going to the expense of experimenting with any of them. As in all other industries, however, the value of economy will probably be realized at all points, as profits become smaller.

The recent discovery of fuel oil in the districts in which the plants are located seems to point to the adoption of this fuel in the near future by the cement plaster industry. Experiments were made by the Acme company at one of its mills, some time ago, with oil for fuel; but, owing to the uncertainty of the contract it was able to secure with the producers, the company did not feel warranted in going to the expense of equipping its plant with the proper appliances, and adopting oil as fuel.

Much remains to be done in the way of a careful and thorough study of the exact chemical composition of the gypsite, and the best methods for combining the various portions of the deposits, as the setting time seems to be greatly influenced by variations in the composition, and this setting time is the all-important point to be controlled.

MONIER CONSTRUCTION.

E. Lee Heidenreich has contracted with the Illinois Steel Co.'s South Chicago works for covering the entire casting floors around their new monster furnaces, Nos. 9 and 10, with Monier plates and arches constructed to carry a safe live load of 800 lbs. per square foot. The beams are entirely encased in cement mortar, so no steel work will be exposed to the fumes and gases around the furnaces.

Montgomery Ward & Co. have awarded to E. Lee Heidenreich the contract for a Monier water tank forty feet in diameter and eight feet high, covered by a Monier arch without center support.

At Bloomington, Ill., some 5,500 lineal feet of conduits are being covered with Monier plates under the direction of Mr. A. C. Warren, under license from E. Lee Heidenreich, owner of the Monier patents in the United States.

PACIFIC COAST CEMENT PROJECTS.

There are four different projects on foot for the erection of Portland cement plants in the state of Washington or just over the line in British Columbia.

Fairhaven, Whatcom county, Washington parties are considering the erection of a plant eight miles from that hamlet.

These people are likewise considering a proposition for uniting with English and American capitalists to erect works in British Columbia where considerable preliminary work has already been done, the materials being suitable for lime, plaster of paris and Portland cement. Tests have been made of the same in England and Germany.

The third project is located near Sumas, Whatcom county, Washington, near the Canadian border. The fourth project is under consideration by the largest lime manufacturers in the state. Should any one of these projects mature the others are likely to follow. Most of the cement used on the north Pacific coast is imported from Europe in vessels conveying grain to Europe. The trade in cement being in the hands of a few people, who are more or less identified with the projects above enumerated.

There is one Portland cement plant in operation near Vancouver, B. C., erected by Canadian Pacific railway officials and now under lease to J. Kieth Fisher and associates.

A TESTIMONIAL.

CHICAGO, April 12, 1901.

CEMENT AND ENGINEERING NEWS,
William Seafert, Editor and Publisher,
Chicago.

DEAR SIR:

Unsolicited we beg to state, that from none of the excellent trade journals in which we are carrying advertisements, have we realized better, and but few, as satisfactory results, as we have from our advertisement in your clean and unpretentious publication.

Wishing you the success which your journal so richly merits, we remain

Very truly and sincerely yours,
McKELVEY CONCRETE MACHINERY CO.
By S. P. McKELVEY, *President.*

RUSSIAN CEMENT CONGRESS.

The seventh Russian Congress of Cement Experts and Manufacturers convened at St. Petersburg, March 30th. N. A. Belebuski, vice-president in the chair. The chairman stated that statistics showed thirty-six Portland cement works and three hydraulic works in Russia. The greatest number of these works are located at Zartum, Poland. The yearly output of twenty-one works for 1900 was 3,500,000 barrels, there being no exact data for the remaining works. The maximum output for the entire country for 1900 being fully 5,500,000 barrels.

The first Russian cement plant was erected in 1856. A few works were built during the next thirty years. The greatest increase of new works erected was during the last ten years.

Professor A. R. Schuljatschenko, president of the congress read a paper on the cement exhibits at the last Paris exposition, where England and Germany made no exhibits. The French and Russians made full exhibits and most of the cement works in both countries were awarded prizes.

The session of March 31 was devoted almost entirely to the reading of papers on concrete and steel construction or rather on Portland cement mortar combined with steel construction after the Monier system. Engineer N. K. Pjatnizki read a paper on the cement mortar and steel construction system Hennebique, which paper was well received.

Engineer N. A. Schilkewitch read a paper on the application of cement mortar and imbedded steel for sewer construction. Prof. N. A. Belebuski read a paper on the historical development of steel and cement mortar construction. One thousand copies of the proceedings of the congress were ordered printed.

The Russian government was requested to increase the duty on imported cement in order to protect home manufacturers.

CONCRETE CONSTRUCTION.

Extracts from a paper by Mr. Neher, read before the Engineers' Society of Western New York.

I am a believer in the use of a wet mixture, and of such proportions as to give a maximum of strength under compression, always using Portland cement, and where economy is necessary I would introduce large stone in the heart of the mass, or cellular construction, but would not cheapen the concrete.

My remarks will be from the standpoint of the purchaser and contractor, as well as the engineer. As engineers I think we are apt, in our desire to secure good work and uniform results, to introduce unnecessary refinements, resulting in increased cost, retarding the progress of the work, and often defeating the end in view.

In connection with this I will first take the subject of specifications, and right here would say that as concrete is almost always used in compression, I would recognize no test but that of the actual mixture to be used in the work, and that under compression. This demonstrates the excellence of all the ingredients, and if they are properly proportioned, it is often the case with excellent ingredients, that low results are obtained by reason of wrong proportions. To illustrate, last summer I had occasion to test the value of copper slag and lake gravel in concrete. The gravel alone, mixed 5 parts gravel to one of cement, was good for about 60 tons ultimate compression in seven days. The standard of excellence desired was that obtained by limestone and gravel, which mixed 1 cubic foot of cement, $2\frac{3}{4}$ cubic feet of limestone, passing a 2-inch ring, everything from $\frac{1}{2}$ inch and under excluded, and $2\frac{1}{4}$ cubic feet of lake gravel, which gave an average ultimate compression in seven days of 135 tons per square foot.

My first tests on the slag mixture gave only about 80 tons per square foot in seven days and appeared to demonstrate a low value for the slag. Examination of the fracture, though, showed an excess of gravel, and a fracture through the spaces where the most gravel existed. A slight diminution in the quantity of the gravel gave results of over 140 tons in seven days.

While mentioning the copper slag, I find from chemical analysis that it appears to be free from deleterious chemicals, except lime. Its use in work of four years' standing seems to prove the absence of free lime. It can be obtained cheaper per cubic yard than stone, but by reason of its great weight (about 3,300 lbs. per cubic yard for run of crusher, against 2,800 lbs. for limestone) the cost of transportation and handling is increased. Owing to its weight and abrasive qualities the duty is harder on the mechanical mixer and tools, and is more apt to separate itself from the other ingredients when thrown from a height or used with a larger amount of water than limestone, and while apparently economical, it is largely offset by the objections mentioned.

Continuing on the subject of specifications, our object in view is, greatest strength, complete filling of voids, and a smooth exterior, all of which can be obtained by simple means. An excess of fine material, while producing a good finish, weakens the concrete; imperfect filling of voids produces rough work, and is also an element of weakness. Therefore to clearly define the exact proportions to be used in any piece of work necessitates an intimate knowledge of the exact materials that will be used by the contractor to whom the work is awarded. As stone from different quarries does not produce the same fracture or amount of fine material, it is seldom wise to state the exact proportions, except that of the cement to the rest of the aggregates, the remaining ingredients to be so proportioned as to fill all voids, without an excess of fine material, leaving the exact amounts to be determined by experiment with the actual materials to be used when placed on the work.

Specifications should state the minimum size of broken stone allowed, as well as the maximum, as broken stone is graded in five commercial sizes, and to determine the voids it is necessary to know the sizes included in the coarse aggregate. As a measure of economy it is well to specify "run of crusher, dust removed." This is usually sold at 5 per cent less than the graded sizes, and contains about 20 per cent more material, leaving less fine material to supply to fill voids, resulting in a saving of 25 per cent, which will be offset somewhat by greater cost per cubic yard for transportation.

Thorough ramming should always be specified. The general impression amongst men employed in placing concrete is that little ramming is required if the mixture is wet. This is a mistake. Large voids will show in the face of the work if not thoroughly tamped, and the fact that wet mixtures are seldom tamped enough is one of the reasons why it sometimes does not show up so well in testing as compared with dry mixing, which must necessarily be thoroughly tamped.

Thorough mixing should also be insisted on. On all work where an amount to exceed 40 cubic yards per day is placed mechanical means should be used; in this way greater strength and uniformity can be obtained at less expense than by the addition of cement.

A concrete composed separately of several of the commercial sizes of broken stone, gravel, sand, etc., is always expensive. Taking the coarser size stone, passing a $2\frac{1}{2}$-inch ring and filling voids by the addition of the smaller sizes, sand, etc., would take 45 cubic feet to make one cubic yard in place, or a yield of 60 per cent, besides adding to the expense of the handling. Being very difficult to properly proportion by the ordinary laborer, equally good results would be obtained by run of crusher, sand and cement, giving only three ingredients to watch, and resulting in a very material saving of expense. As eternal vigilance is the price of success in concrete work, simplifying of methods is desirable; besides, I think we err when we introduce refinements which at an increased cost give no corresponding results.

To produce smooth work the addition of granolithic face, or plastered surface, is not necessary. Smooth forms, with concrete well proportioned, will give just as smooth work at much less cost, leaving the whole mass uniform, without a line of separation, or different compressive strength. As an illustration of this the concrete foundation and floor of the Eastern elevator and the foundation of the new Dakota elevator are good examples. A large portion of this work was placed in midwinter, and provides that good work can be done at all times and seasons, although the expense is about 20 per cent greater.

Another way to produce finish is to joint the concrete to represent masonry, using rough lumber for forms, then bush-hammering the face, which can be done by an ordinary laborer at $1\frac{1}{2}$ cents per square foot, the amount saved by using rough lumber going a long ways towards paying for the bush-hammering. This removes all impressions from inequality of moulds, efflorescence, etc. The front of the Eastern elevator facing the dock is so treated.

The preparation of forms calls for considerable ingenuity. Every contract requires special study, to the end that smooth surfaces be left, with unbroken corners, that the swelling of the wood does not rupture the concrete or leave distorted surfaces, and that the forms be so designed as to be used several times, and readily set up and taken down, and later on converted to other uses. The charge for forms against the concrete can seldom be kept below 50 cents per cubic yard. For heavy work there is always an opportunity for careful plans, and all depends on the ingenuity of the designer, as few rules can be laid

down for his guidance. The use of matched, or tongue and grooved stuff is not desirable, as concrete fills in the openings and there is no opportunity to expand from moisture. Unmatched boards dry apart and let the water in the concrete leak out, carrying with it some of the cement, later on they swell and buckle, and if used as interior forms burst the concrete. The best way devised so far is to bevel one edge of the boards, using narrow stuff, not to exceed 6 inches. The sharp edge of the bevel lying against the square edge of the adjoining board allows the edge to crush when swelling, closing up the joint, and preventing buckling.

A coat of soft soap before filling the forms prevents the concrete from adhering to the forms, which should always be scraped and brushed with a steel wire brush when taken down. Square corners should be avoided, as they readily chip off, and where used as interior forms for recesses or cellular construction a fillet should always be placed in the corners.

Concrete can often be saved by introducing cells in the mass, either by cheap hemlock boxes, which can be left in the work, or by collapsable boxes which can be withdrawn and used over again. Where weight is desirable, "one-man" stone can be rammed in the heart of the mass, reducing the cost very materially.

Where, for economy in handling or other reasons, it is desirable to dump the concrete a considerable height some precaution should be taken to avoid having the coarse aggregates separate from the rest of the mass, this can be accomplished in several ways, either by chains loosely stretched at intervals across a chute, or by shelves extending part way across the chute at an incline, so as to deposit on a corresponding shelf on the opposite side. So alternating the length of the chute, either of these methods is a direct benefit, as they more thoroughly mix the concrete.

Our building laws as a rule show little knowledge of the value of concrete, ordinarily limiting its use to 16 tons or less per square foot, a larger factor of safety than is required for any other material. This probably is due to the large amount of poor concrete turned out, and also to exclude from the building trades a material that can be placed by unskilled labor.

Regarding the introduction of steel or iron in its various forms in concrete to give tensile strength, there is no question as to its utility if properly used. I claim no special knowledge of any of the systems except the Ransome, which appears to me the best for the following reasons: It is a perfect system from which the entire structure from foundations to roof can be made, without the introduction of I beams, or metal frame work of any description, except moulding in the cold twisted square steel bars.

The cold twisting the square bars receive has many advantages possessed by no other system. The twisting prevents the rod from drawing in the concrete, making the grip on it continuous and uniform. Rendering the strains all equal, it further decreases the ductility of the metal, acting more in harmony with the concrete, a vital point, when the nature of concrete is considered. Incidentally we also gain a marked increase in tensile strength, which in practice we generally throw in as an extra factor of safety. Its application is in its infancy, and in a short time I predict it will be used in many ways not now thought of. Its application so far has been markedly successful. The floor of the Eastern elevator is, I believe, the boldest application to date, of this or any other system, the actual load on the floor is 4,470 lbs., the dead weight of the floor is 300 lbs. per square foot, taking the load as uniformly distributed. When we consider that the grain load is concentrated on the rim of the tank, and generally taken as two-thirds of the whole load, and that the supporting columns, owing to the peculiar layout of the property, have no relation to the position of the tanks; also that in practice some bins are full and others empty, giving eccentric loading, the problem was a difficult one. Its efficiency is still to be demonstrated. Of its success I have no question. The basement floor of this elevator which was built for a live load of 75 lbs. has been loaded over almost its entire surface from 300 to 500 lbs. per square foot, frequently in seven days after being placed, and that in midwinter.

J. H. Killmar was the lowest bidder for furnishing cement to the city of Des Moines, Iowa, during the fiscal year.

The Twentieth Century Portland Cement company organized at Fenton, Mich., last December, located 2½ miles from Fenton, where they have 220 acres of marl land showing an average of 86 per cent Ca. Ca., and by actual borings shows a deposit of 9,500,000 yards of marl. They also have 50 acres of clay on their property and their own fuel deposits. The company has the following officers: President, J. H. Logan; vice-president, E. A. Hollenbeck; secretary, C. L. Corrigan; treasurer, D. G. Colwell; general manager, J. C. Edsall.

A CEMENT PLASTER TRUST.

Until recently there have been several companies operating cement plaster plants in Kansas. A few weeks ago the American Cement Plaster company of Lawrence, with mills at Mulvane and Quanah, Tex., purchased controling interest in the Salina Cement Plaster company, which has mills at Dillon and Langford, Kan., and Quanah, Tex., and the office of the Salina company was moved to Lawrence, and arrangements have now been completed whereby A. D. Mackey of Lawrence has acquired controling interest in the Samson Cement Plaster company of Dillon, Kan., with mills at Burns, Kan.

Joab Mulvane of Topeka, J. A. Henley and A. D. Mackey of Lawrence now virtually control the stock of the three named cement companies, and as the headquarters of the Samson Cement Plaster company will also be moved to Lawrence it is presumed they will all three be consolidated into one company under the name of the American Cement Plaster company.

The German Portland Cement Co. will erect a plant at White Pigeon, St. Joseph county, Mich.

The plant of the Chickamauga Cement Co., near Chattanooga, Tenn., is rapidly nearing completion.

The Peninsula Portland Cement Co.'s works at Cement City, near Jackson, Mich., have started up.

The plant of the Dennison Wall Plaster company at West Uhrichsville, Ohio, was totally destroyed by fire on the 11th inst. All the finished product, all material in process of manufacture as well as the machinery was destroyed.

Representative plaster manufacturers from several states met at Kansas City on April 17th, in executive session. The principal object of the meeting was to frame a protest to be sent to representatives of the Western railroads against any further advance in the plaster rate from points west of the Missouri river. A short time ago the rate on lime was advanced from two to five cents a hundred, and the plaster men say such an advance on plaster would be prohibitive. Those present were Hewitt Boice of Kingston, N. Y., who has valuable gypsum mines in Oklahoma; F. T. Sunderland of Okarche, Okla.; S. F. Paul and A. E. Winter of Blue Rapids, Kan.; Arthur English of Omaha; J. C. Burch and R. W. Laflin of Wymore, Neb.; J. A. Henley and J. H. Henley of Lawrence, Kan., and J. Mulvane of Topeka.

THE CHICAGO PORTLAND CEMENT COMPANY.

The Chicago Portland Cement Co., manufacturers of AA brand of Portland cement, is the oldest Portland cement company in Illinois, originally located at Hawthorne, a suburb of Chicago, up to February, 1898, when its plant was destroyed by fire. After this date the company located at Oglesby, Ill., where it controls about 2,000 acres of land containing an abundance of lime rock and shale clay suitable for the manufacture of high grade Portland cement. Analysis of these raw materials show:

	Limestone.	Clay.
Silica	6.06	53.12
Alumina		20.60
Iron Oxide	3.92	4.09
Lime	49.46	4.02
Magnesia	.91	2.24
Sulphuric Anhydride	.10	
Ignition Loss	39.06	13.70

No more favorable materials for making a superior Portland cement are to be found in America. A similar limestone is used in the best German Portland cement works under the name of Muschel Kalk or shell lime. The deposit is averaging 22 ft. thick. The shale clay, 5 ft. thick, underlies the lime rock, and the quality of coal adjoining the company's land is excellent. We show a view of the plant and a part of the quarry.

WORKS OF THE CHICAGO PORTLAND CEMENT CO.
At Oglesby, Illinois (near La Salle).

The main building is 320 ft. long by 52 ft. wide. The raw grinding room and finishing mill room are each 74 ft. long by 64 ft. wide and form wings to the main building. The engine building and boiler house are each 50 by 60 ft. The stock house is 70 by 200 ft. The mill equipment consists of Gates crushers, Krupp ball and tube mills and rotary kilns. The power is supplied by a Greene-Wheelock cross compound condensing engine of 1,000 horse power, B. & W. water tube boilers, electric generators, electric motors, etc. Electric transmission of power is used largely for the machinery throughout the mill and in the quarry. Compressed air drives the quarry drills.

The cement is manufactured by the dry process. The rock and clay is carried by an aerial tramway from the deposits direct to the mill building and into two revolving dryers, where it is stored in bins and automatically delivered, as required, by elevators, conveyors and automatic feeders into ballmills and partially reduced, and by another system of conveyors it is automatically conveyed into tubemills and reduced to a very fine powder, which flows in a continuous stream to feed bins above the kilns, mechanical feeders discharging the raw cement powder as required in the rotary kilns, where it is converted into cement clinker at a temperature of about 3,000° F. by the use of pulverized coal fuel forced into the rotary kilns by air pressure fans.

The clinker is continuously discharged from the kilns and automatically cooled and mechanically stored by conveying machinery. From the storage bins automatic conveyors take the clinker to ballmills, where it receives its first reduction, then it passes on to the cement tubemills, where the cement clinker is finely pulverized and conveyed to the stock house, which has a capacity of 40,000 bbls. Here the finished cement is packed in bags and barrels by machinery, ready for shipment.

"Chicago AA" Portland cement is guaranteed:

1. Uniform in color.
2. Sound and reliable, passing all reasonable tests, such as the hot test and cold water test.
3. Strength satisfactory and increasing steadily with age.
4. Fineness equal 95 per cent to pass 100-mesh United States standard sieve.

Concrete Conduit in Bloomington, Ill.
Chicago AA Cement Used. Laid by Hoffer & Co., Chicago.

Abutment, Ill. Cent. R. R., near Iowa Falls, Iowa.
Chicago AA Cement Used. Built by Geo. Scribner, Jr.

The company has excellent shipping facilities: Illinois Central Railroad by direct switch to factory; Chicago, Burlington & Quincy Rail-

road by direct switch to factory; Chicago, Rock Island & Pacific Railroad at La Salle; I. I. & I. Railroad at Lostant; C. & E. I. Railroad at Joliet; C. & N. W. Ry. at Spring Valley and Dixon; Atchison, Topeka & Santa Fe Ry. at Streator.

The officers of the company are: Norman D. Fraser, president; D. R. Fraser, vice-president; Ralph Gates, secretary and treasurer. The main office of the company is in the Stock Exchange building, Chicago, Ill.

The company has established an excellent reputation for its cement throughout the West, where it enjoys a large trade with cement sidewalk contractors, railways, and on public and private works, the entire product being marketed by the Garden City Sand Company of Chicago.

Chattanooga, Tenn., has eighteen new factories under construction.

The T. Millen & Co. Portland cement plant at Wayland, N. Y., has started up.

Work has been started on the Iroquois Portland Cement Co.'s plant at Caledonia, N. Y.

The Omega Cement Co. has started up for the season and has commenced shipping cement.

J. C. Enders of Constantine, Mich., has contracts for 2½ miles of cement walk to be laid in Kenmore, Mich.

E. A. Wickham & Co., Council Bluffs, Iowa, have contracted to finish 93,394 square yards of paving at Omaha, Neb., during the present season.

The Zenith Portland Cement Co. has purchased eight rotary cement kilns of the Bonnott Co. of Canton, Ohio, for their plant at Grass Lake, Mich.

The Lupton Portland Cement Co.'s surveyors are driving stakes for the lines of its mill site and a road bed for a line to connect the mill and marl deposits.

The Milburn reservoir forming a part of the Brooklyn, N. Y., water supply will be lined with concrete. $500,000 worth of bonds have been authorized to defray the cost of the improvement.

Messrs. Olemacher Bros., formerly of the Olemacher Lime Works, Sandusky, Ohio, will erect a lime sand brick plant at Michigan City, Ind. Capacity, 200,000 brick per day. The process used will be after the description given in the March issue of the CEMENT AND ENGINEERING NEWS, in describing the manufacture of lime sand stone as carried on in Germany where there are now over 140 plants in operation.

CONCRETE BRIDGE, PIQUA, O.

The illustration on page 49 shows a simple form of concrete bridge of monolithic construction and eminently suitable for country highways where cheap and substantial bridges are desirable and can be built with comparatively unskilled labor. The work was done as follows: The creek over which the bridge was erected was diverted during the construction. Excavations were first made for the abutments and wing walls below the bed of the stream to hard gravel forms were erected and concrete mixed 1, 2 and 6 and deposited directly on the gravel foundations through and into water covering the excavations. The wing walls were 2 feet thick and the abutments 3 feet thick. After the abutments and wing walls were in the approaches they were filled in with earth. The space between the abutments, 14 feet, was next filled in with earth and shaped to conform to the plan of the arch and covered with one inch boards and tarred paper. This was all the centering used. Wooden forms were next put in place for the sides of the arch, a 3-inch layer of concrete mixed 1 cement, 2 fine crushed stone and five coarse crushed stone was spread evenly over the false work and six square iron rods 1 in cross section were then laid on the concrete extending from abutment to abutment, 3 feet from centers and conforming to the curve of the arch. Concrete was deposited on the false work and tamped to make an arch 16 inches thick at the spring line and 10 inches at the crown. The arch being 14 foot span; the work on the arch being finished in a single day. The side walls were next placed 10 inches thick, the facing for the bridge was stone dust mortar one of cement to two of stone dust laid on one inch thick. Two bridges of this class, one with a span of 22 feet were built last season and no defect has been found in either bridge. Earth filling was used over the arch for the road bed and to secure a proper grade for the approaches. Such a bridge can be built by any concrete sidewalk contractor, as there is a great future for this class of work we advise all cement sidewalk contractors to follow it up, wherever the opportunity presents itself and thereby enlarge the scope of their avocation and income.

The Empire Portland Cement Co. will install five rotary kilns. The capacity will be increased to 800 barrels per day. The opening of the mill will be deferred to some time in June. The company has now 45,000 barrels of cement in store at the works and 10,000 barrels at Chicago.

Burlington, Iowa, will purchase a stone crushing plant.

The Iroquois Portland Cement Co. are excavating for the mill site. The New York Central railway has completed a switch track into the company's grounds.

Incorporated: Atlas Plaster Company of New Jersey to manufacture Portland cement. Capital, $250,000. Harry P. Miller, Hoboken, N. J.; Abraham L. Angle, G. F. Waddell et al.; Weller & Lichtenstein, attorneys, Hoboken, N. J.

Incorporated: Decorative Marble Company of Trenton, N. J., to manufacture plaster, cements, etc. Capital $75,000. Gustav S. Dorwin, Jersey City, N. J.; Robert C. McCormick, H. A. Tucker et al. Keating & Walradt, attorneys, New York.

Edward G. Durant of Pasadena, Cal., has organized a company to manufacture ornamental cement tile and hollow building block and trimmings for buildings. The works, 48x100 feet, will be erected at East Los Angeles on the Southern Pacific railway.

Cement production of Canada for 1900 was as follows: Natural rock cement, 125,428 barrels valued at $99,994; Portland cement, 283,124 barrels valued at $545,826. These figures are from the Geological Survey of Canada, compiled under the direction of E. D. Ingall.

A stock company, with a capital of $50,000, has been formed at Athens, Mich., to manufacture fence posts of sand and Portland cement, the invention of C. L. Huxley. The company will do business under the name of the American Cement Post Co., Ltd. The company has $37,000 paid in.

The Kinderhook Portland Cement Company, incorporated under the laws of West Virginia, with a capital stock of $500,000, will open offices in Indianapolis, Ind. The stock of the company is controlled by Indiana investors, several Indianapolis men being among the number. The company owns large tracts of marl and clay lands near Kinderhook, Mich., and Fremont, Ind.

Seventy-five Medina paving stone quarries in Western New York producing Medina paving blocks are about to form a combine with a capital of $1,500,000. This stone is largely used in New York, Ohio and Pennsylvania in preference to granite blocks. Many of the quarries are now in the hands of farmers unfamiliar with correct business methods. Contractors using this stone favor the combine as it will give them quicker deliveries and a more uniform product.

A COMMUNICATION.

CENTRAL TECHNICAL BUREAU,
MONIER CONSTRUCTION,
541 THE ROOKERY, CHICAGO.

MR. WM. SEAFERT,
Chicago, Ill.

DEAR SIR:

The following item appeared in the *American Elevator & Grain Trade* of April 15, 1901.

"Being satisfied that the break in the concrete elevator at Duluth in December last was due wholly to local causes and not to a defect in the system of construction, the Peavey Grain company has given orders for the completion of that plant according to the original plans. Only one-half of the plant as designed had been finished before the break came. This bin has been repaired, and the other concrete cells have been full of grain all winter. When completed, the new elevator will be unique in construction and also one of the largest elevators on the continent.

Yours very truly,
E. LEE HEIDENREICH.

PROOF OF THE DURABILITY OF MONIER CONSTRUCTIONS.

By E. LEE HEIDENREICH.
M. W. Soc. E. M. Am. Inst. Min. E.
(After *Le Cement.*)

When enemies of Monier construction or fortified mortar structures attempt to meet arguments, they generally retrench themselves behind the statement, "you cannot prove the durability of fortified mortar constructions." Quite a number of engineers, without being hostile to this new construction, hesitate in availing themselves of the new system simply because they do not know anything about its durability. We know that the mortar or the concrete becomes stronger with age, but what becomes of the iron? Does it oxidize or otherwise deteriorate? All those who have destroyed constructions of fortified mortar have agreed that the iron has been most admirably preserved, but it is not everybody who has witnessed such destruction, and whoever has not seen is not willing to believe.

The well known French engineer, M. Hennebique, determined several months ago to cause an official inquiry into the preservation of iron or steel in fortified mortar. He sought the most disadvantageous conditions so as to make the conclusions the more absolute, and determined to look into the condition of water pipes located in the moist soil.

The mayor of Grenoble, in France, finally advised Mr. Hennebique of the fact that they had a lot of 12-inch water mains, which were constructed in 1886, which had been working under a head of about 75 feet for 15 years, and offered Mr. Hennebique an opportunity to take up part of the pipes for the purpose of experiments. The test took place the second day of February, 1901, in the presence of a number of delegates both from the city of Grenoble, from engineers of Pont at Chaussees, and delegates from several other cities to whom the experiments were interesting. The test was conclusive and it may be said to-day, with absolute certainty, that these steel wires, from $\frac{1}{8}$ inch to $\frac{1}{4}$ inch diameter, have been preserved intact for 15 years in a mortar wall of $1\frac{3}{8}$ inch thickness. There is no reason why this preservation should not continue indefinitely, and as the durability of fortified mortar, as in Monier construction, depends principally on the durability of the embedded wires, the result is the durability of fortified construction is without limit, even under the most unfavorable conditions. The following is a copy of the report of a test, February 2, 1901:

CITY OF GRENOBLE, FRANCE.

Official Inquiry Regarding the Preservation of Steel in Cement Mortar.

In 1886 the municipal administration executed, as a test, some 300 feet of water pipe according to the system Monier. These pipes were connected with the regular cast iron system and had withstood, and still do withstand, a normal water pressure of 75 feet head. The length of the single pipes is 6 ft. 3 ins., thickness is $1\frac{3}{8}$ ins., interior diameter, 12 ins., exterior diameter, $14\frac{3}{4}$ ins. The steel skeleton is formed by 30 longitudinal rods $\frac{1}{4}$ in. diameter and one interior spiral $\frac{5}{32}$-in. wire, one exterior spiral $\frac{1}{4}$-in. wire. The intersections are connected by annealed wire. The exterior spiral is very close to the outside of the pipe. The mixture was two volumes cement to one volume sand. The total weight of steel per lineal foot was $5\frac{1}{2}$ lbs., and the steel was not galvanized, but black. The second day of February, 1901, at nine o'clock in the morning, this pipe was taken up for a length of about 14 ft. in the presence of the following gentlemen:

Collard, bridge engineer of Grenoble.
Argoud, delegate from the director of Public Works of Grenoble.
Riboulet, section chief of the city of Grenoble.
Herzog, civil engineer, delegate from the city of Geneva, Switzerland.
Rochat, civil engineer, delegate from the city of Lausanne, Switzerland.
Lepine, directing engineer of the Hydro-Electric Society of Fure et Morge.
Rossigdol, manufacturer of cements at Grenoble.
Delamarche, from Geneva.
J. Chanvannes, banker of Lausanne.
De Mollins, general agent of the Hennebique patents in Switzerland.
De Crousaz, general agent of the Hennebique patents in Lyons.

Three pipe sleeves are broken off so as to disengage two pipe lengths of 6 ft. 3 ins. each. The following are the results of the tests witnessed by the above gentlemen:

First—An irreproachable state of preservation of the pipes, in which was found in one spot of about 4 ins. about $\frac{1}{32}$-in. of a layer of a lime deposition on the inside of the pipe. The pipes did not present the least hair crack inside or outside.

Second—Not a trace of oxidation of the steel existed, not even in the sleeves of the pipes, which were carefully examined after the mortar had been removed. The annealed wires used for tying the intersections were absolutely intact.

Third—The adhesion between the metal and the cement mortar constituting the body of the pipes was such that they could not be separated except by heavy blows, notwithstanding the small thickness of the pipe.

Fourth—Smart blows with a 3-lb. hammer gave a remarkable metallic sound, corresponding to that of the cast iron pipe of the same diameter.

Fifth—The broken fragments of cement mortar show plainly broken pieces of gravel adhering to the mass.

Sixth—The water works service of the city of Grenoble declares that the pipe has caused them no repair whatever since it was put in.

The action of the Fort Scott (Kan.) city council in permitting the use of Fort Scott hydraulic cement on the public works of the city, has induced other cement manufacturers to reduce prices below the Fort Scott cement. Now a general war of prices is on.

The Great Northern railway will change the motive power from steam to electricity through the Cascade tunnel, which is 13,500 feet in length, to overcome the injurious effect of gases and smoke emitted by the engines in passing eastward through the tunnel, which rises 200 feet to the mile from west to east calling for the service of several engines to overcome the grade. The prevailing winds from west to east keep the trains constantly surrounded by these escaping gases. Water power will be used to develop the electrical energy for the motors hauling the trains through the tunnel. The Cascade tunnel is lined throughout with Portland cement concrete. It was opened to traffic Dec. 15, 1900.

The state of California has placed a law upon its statute books regulating building contracts which renders null and void all contracts which refer to plans and specifications for work to be done, unless such plans and specifications be completed and signed by the parties to the contract at the time of the execution thereof, and include detail drawings sufficient to show the materials, form and dimensions of the proposed works, and upon a scale of at least one and one-half inches to the foot. Any provision in such contract leaving to the architect or other person the power to determine what materials shall be furnished, or work done shall be void, except in so far as the same leaves to such architect or person the discretion to determine whether such work and materials are in accordance with the contract, plans, specifications and details.

DYCKERHOFF PORTLAND CEMENT.

On application, E. Thiele, 99 John Street, New York, will mail to you a letter explaining the defect most frequently occurring in Portland Cement, and stating good reasons why for important work the Dyckerhoff brand should be selected, notwithstanding its higher price.

MAILED ON APPLICATION—"Hand-Book of Useful Information for Cement Users." Compiled by E. Duryee, C. E., Portland Cement Specialist, Colton, Cal.

FOR SALE OR LEASE.

A Portland cement deposit of several hundred acres; also another deposit of about 100 acres. The deposits are near this place and close to a cement plant, where at least $150,000 have been invested in machinery. Will send a sample of fertilizer to any one wanting it. Write to A. P. DYKE, Hope, Ark.

SITUATION WANTED!

By a superintendent; experienced both in erecting and operating a large Portland cement plant. Best of reference and thoroughly competent. At present connected with one of the largest cement plants in Michigan. Address "MICHIGAN," care of *Cement and Engineering News*, 162 La Salle St., Chicago.

POSITION WANTED!

As Chemist by a University Graduate; have had experience in one of the largest Portland Cement Factories in the United States. Address "GRADUATE," care *Cement and Engineering News*, Chicago.

YOU CAN SAVE MONEY!

If you send me your CATALOGUES and ADVERTISING. I write, illustrate, edit and prepare them for the printer, and save you all bother. Highest testimonials as to ability; charges moderate. TIMMONS, Room 68, 161 La Salle Street, Chicago.

FOR SALE.

One Hundred Acres of Cement Rock and Lime Land, situated at Martin's Creek, Northampton County, Penn. Must be sold in order to close up an estate. Shipping facilities unexcelled. Address

C. W. KELLER,
Belding Bros. & Co.,
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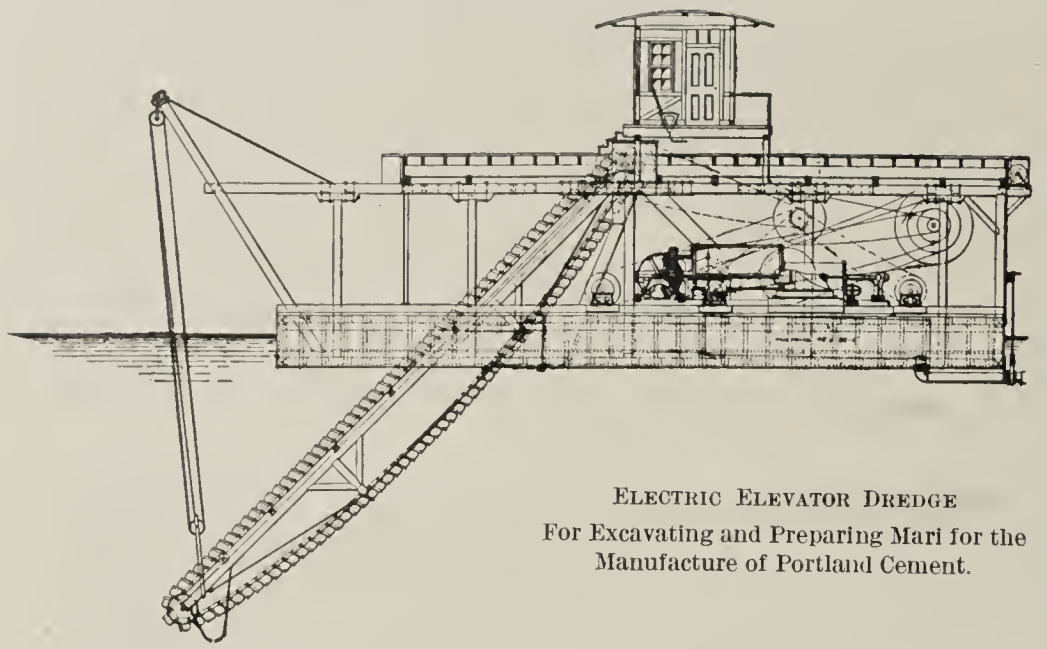

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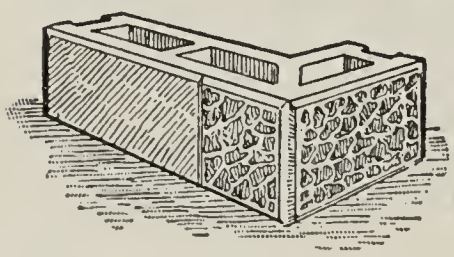

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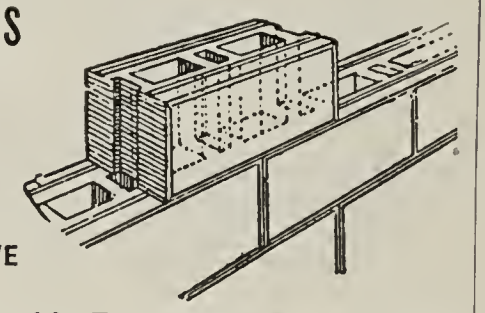

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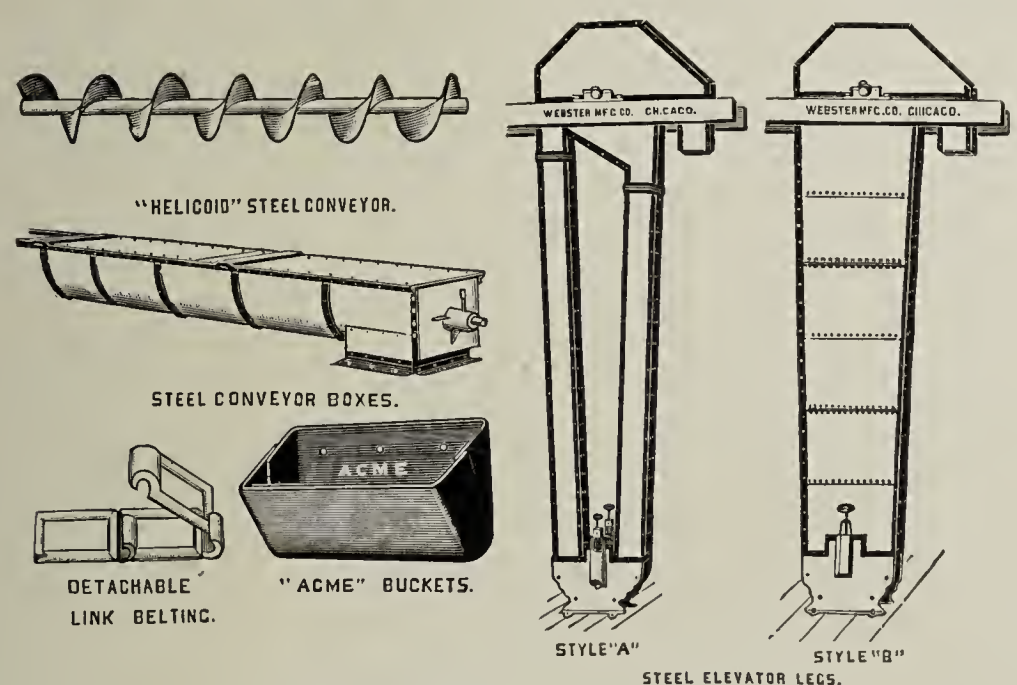

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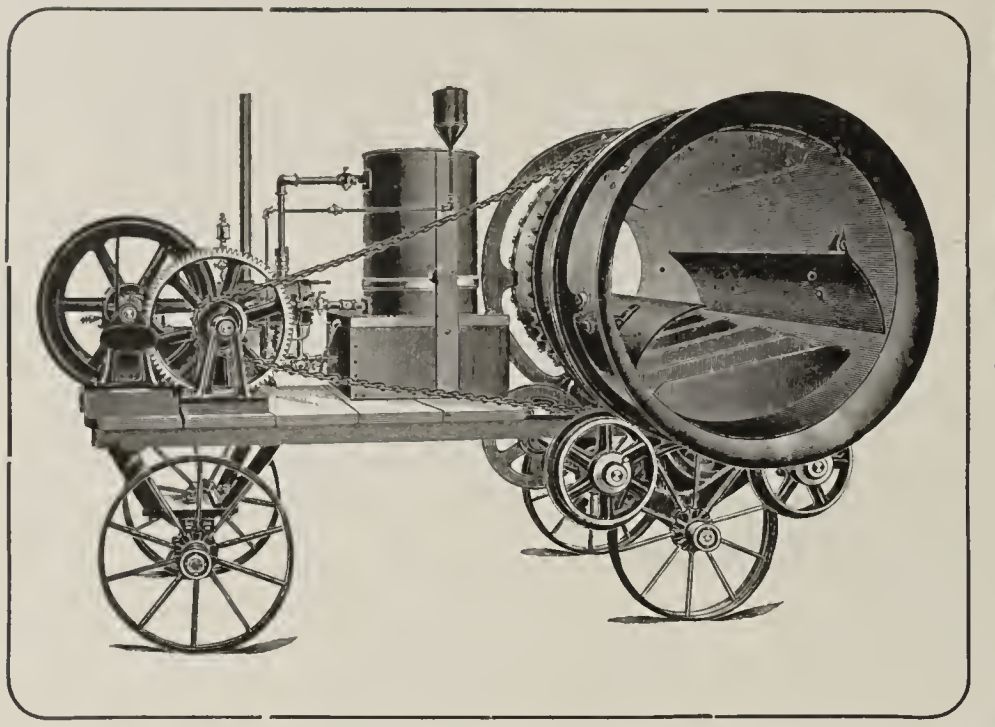

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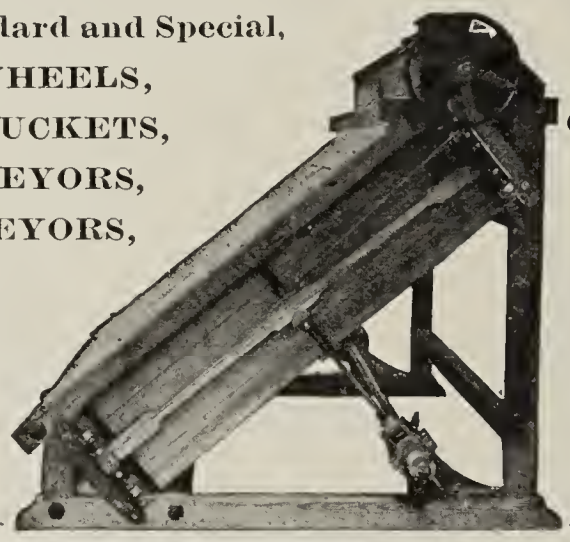

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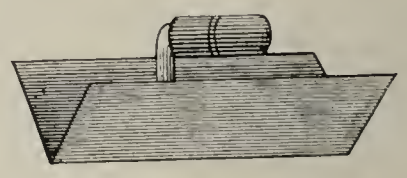

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FROST AND CONCRETE WORK.

The effect of frost on concrete has engaged the attention of engineers and architects for years, no settled opinion having been reached. The Austrian Society of Architects and Engineers made numerous tests under government supervision. The results of these tests demonstrated that concrete made during the coldest winter weather and deposited in forms made of one-inch boards gave entirely satisfactory results for all practical purposes. The concrete piers on one branch of the Metropolitan Elevated Railway of Chicago were put in place during the coldest winter weather, the water used in mixing the concrete being heated. The boxing for these piers was 2-in. plank in each pier and four $1\frac{1}{4}$-inch steel bolts were imbedded during the placing of the concrete, the screw threads projecting above the surface of the pier to which the superstructure was subsequently bolted. Not a single concrete pier was injured by the frost.

The cinder concrete floors of the new Inter-Ocean Building, Chicago, were placed in January, 1901. Tests made on these floors in March showed that the concrete was absolutely sound.

F. B. Abbott, architect of Chicago, seven years ago erected a dwelling for a client, the outside walls being cement finish on expanded metal; the work was delayed and not ready for the outside walls until mid-winter. The cement contractor finished the entire outside cement plaster work during the coldest zero weather, against the protest of the architect. Every square inch of the outside cement plaster was frozen solid and the architect expected to see the entire outside walls drop off with the first thaw, but this was not the case. The work turned out strictly first-class, and does not show a flaw or crack after seven years weathering.

After cement has set it may be exposed to severe freezing without ill effect. The use of hot water and heating the sand, clinker or crushed stone usually carries the concrete mass over the critical point in zero weather but there should be no overwetting of the concrete.

Salt water is sometimes used to protect the concrete from the effects of frost; one pound of salt to 18 gallons of water at 32° F. being used to wet the concrete. Salt water, however, produces efflorescence. Heating the water and aggregates seems to be the better practice. Concrete work in actual contact with the earth is less liable to be injured by frost than where there is no contact with the earth. The same is true of freshly quarried stone. The writer has seen newly quarried blocks of stone full of quarry sap loaded onto flat cars, while others ready for loading rested on the earth over night with a temperature of 5 degrees below freezing; the stone on the cars being shattered by the frost while the blocks on the earth were not injured in the least.

The Mutual Life insurance company of California has brought suit to determine the title of land areas on Stover Mountain, just west of the California Portland Cement Company's plant, the ownership of which is claimed by the cement company.

The new Marshall Field building, southeast corner of State and Randolph streets, Chicago, now under construction, will be carried on ninety-five concrete piers 88 feet 6 inches deep and 73 feet below city datum, the smallest being 5 feet 9 inches and the largest 8 feet 6 inches in diameter and from 13 to 18 feet in diameter at the base, diminishing to the diameter of the pile 12 feet above the base. It requires 40 hours to deposit and tamp the concrete when the excavation is ready for the same. The excavation and placing of concrete piers will cost nearly one thousand dollars each.

The works of the Sandusky Portland Cement Co. at Syracuse, Ind., began operations January 1st, and the manufacture of cement was carried on steadily throughout the extreme cold weather. About 750 barrels per day are now being made at Syracuse, and this will be increased to 1,000 barrels as soon as some small additions, now in progress, are completed. The factory of the Sandusky Portland Cement Co. at Sandusky was in continuous operation throughout the winter, with the exception of a few days shut-down for general repairs. The output of the mill now averages over 600 barrels per day.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	MARCH.				NINE MONTHS ENDING MARCH.			
	1900.		1901.		1900.		1901.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	1,251,227	4,476	200,000	781	62,653,294	247,512	59,605,832	231,430
Belgium..	26,230,961	79,234	4,435,129	12,206	208,055,646	622,166	185,761,195	579,679
France	374,000	1,674	.....	.....	4,397,345	16,595	11,178,158	39,854
Germany.....	36,052,244	135,939	11,084,803	39,796	355,580,762	1,272,742	257,151,108	921,134
All Other Europe ...	1,511,894	5,191	1,841,600	5,330	18,807,614	61,499	21,328,219	62,444
British North Am...	.....	.....	1,814	21	897,790	5,111	1,258,460	6,622
Other Countries.....	842,300	3,790	20,565	95	3,441,160	16,452	5,418,525	22,410
TOTAL	66,262,626	230,304	17,583,911	58,229	653,833,611	2,242,077	541,701,557	1,863,573
Domestic Exports of Cements, bbls.	6,390	15,738	24,002	43,089	54,252	114,090	118,446	252,372

There were 6,798,906 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on March 31, 1900, valued at $21,194, against 7,280,577 lbs., valued at $24,992 in March, 1901.

Imports of asphaltum or bitumen for March, 1900, were 11,153 tons valued at $40,361; March, 1901—15,260 tons valued at $38,261. For nine months ending March, 1900, 79,687 tons valued at $249,571; for nine months ending March, 1901—98,032 tons valued at $344,653.

A CONCRETE CHIMNEY.

By Ralph C. Davison.

The increased use of concrete for building purposes has taken rapid strides within the last five or six years. No architect of the present day questions its durability. A series of experiments extending over a period of twenty years demonstrated that concrete grows harder as it grows older.

Thousands of dwellings have been built of concrete in England and Continental Europe. Of these, many, after more than half a century, prove their practical indestructibility.

A fine example of concrete work is that of the lighthouse at Port Said, which is 180 feet in height.

The reasons why this desirable material has not been more generally used are: First. The great compressive strength of concrete (the power to resist crushing) could not be utilized on account of its lack of tensional strength (the power to withstand a pulling strain). Second. Because there was a lack of efficient appliances for making and molding it.

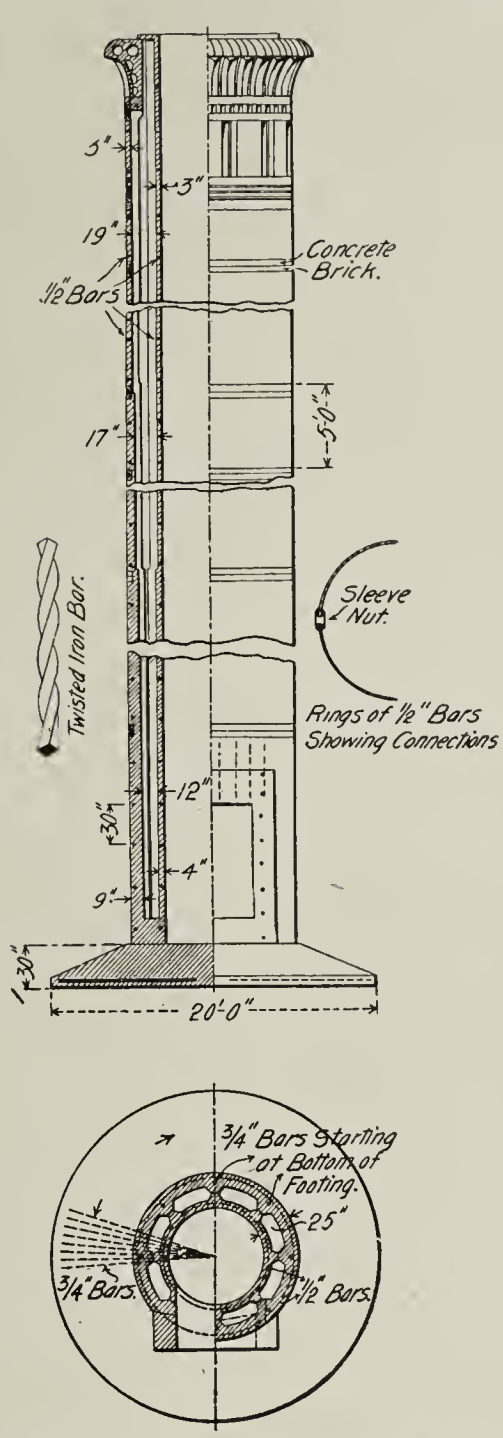
The complete success of concrete construction to-day is due to the introduction of what is known as the "iron-concrete construction," or reinforced concrete. The basis of this system is a combination of iron and concrete; the iron is imbedded in the concrete in such a manner as to give the concrete all the tensional strength of the iron, and at the same time to fully utilize the immense compressive strength inherent in the concrete.

The tensional strength of the steel or iron, which is about 30 tons to the square inch, increases the strength of the concrete about one hundred fold. Many different forms of iron are used in concrete construction, such as iron net, square iron bars, twisted iron bars, etc.

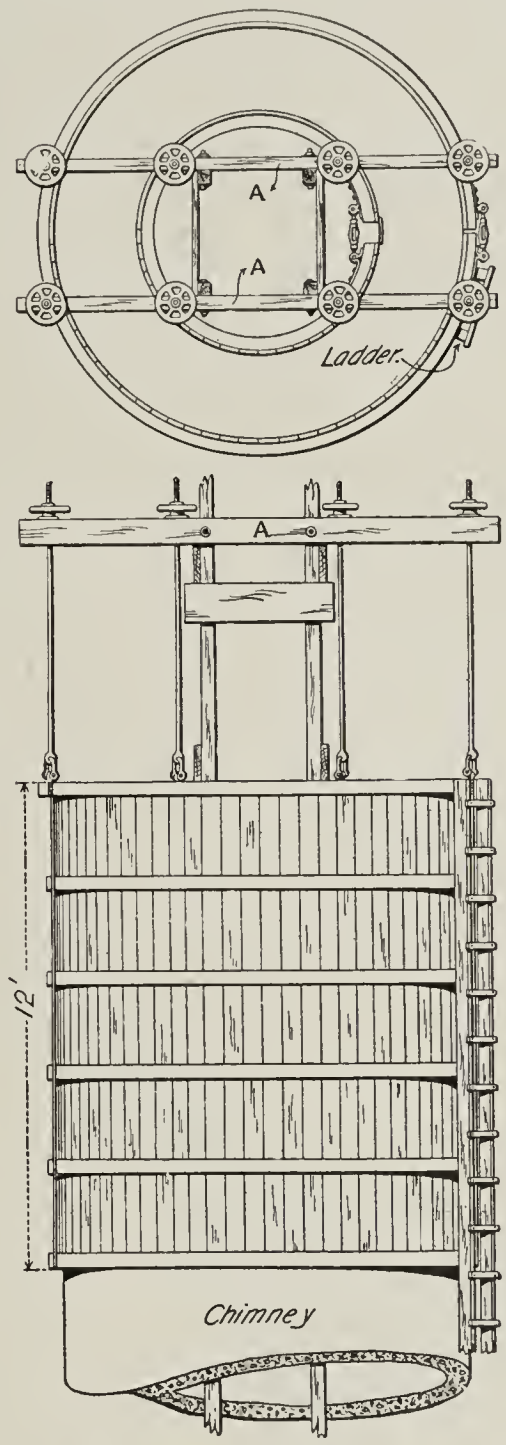
Concrete-iron construction is universal in its application, covering the entire field now occupied by stone, brick, and terra cotta, such as stairs, foundations, walls, floors, fortifications, sidewalks, etc.

The advantages derived from using concrete are not only simplicity in construction, but the fire-resisting qualities of concrete are far superior to those of any other building material now in use.

A new departure in concrete construction is that of chimney-building. A concrete chimney has just been completed for the Singer Manufacturing Company at Elizabethport, N. J. This chimney is of the Ransom cold-twisted-iron construction, and is the second of its kind in this country; the first, a chimney 150 feet high, with walls less than 12 inches thick, was built about three years ago at Bayonne, N. J., for the Pacific Coast Borax Company. This chimney has given perfect satisfaction and has withstood a number of severe wind storms. All the buildings of this company are of concrete throughout. The Singer chimney is a straight chimney 125 feet high, with a 9-foot flue. It weighs 250 tons, the load on the base being 9½ tons to the square foot; 20 pounds per foot was allowed for wind pressure in designing the chimney. What is known by concrete men as "wet" concrete was used. By a wet mixture is meant one which quakes slightly when rammed; by dry mixture is meant one which requires repeated ramming to bring water to the surface. The concrete was mixed according to the following proportions: 1 part American Portland cement, 3 parts sand, 5 parts broken Hudson River limestone. (Stone broken to pass through a ¾-inch ring unscreened.) All of the concrete used was machine mixed, this process being much quicker and cheaper than mixing by hand. The method used in constructing this style of chimney is ingenious and novel, and is covered by patents. In laying the foundation for this chimney no piles were used; the ground was simply leveled off and the concrete laid as shown in Fig. 1. Cold-twisted iron bars were imbedded in the foundation, radiating from the center, as shown. Twisted rectangular bars are used for the reason that the spiral ribs formed upon the iron make a continuous lock between the bars and the concrete. It was also shown by test that the tensile strength of twisted bars was considerably more than bars that were not twisted. The following table shows the increase of strength of iron bars by reason of twisting. When the foundation is thoroughly set, a mold is put in place and the actual building of the chimney commences. This mold is constructed as shown in Fig. 2. It is filled with concrete, through which iron bars are distributed as shown in Fig 1. This concrete is then thoroughly tamped and allowed to set. It will be noticed that the chimney has an inner and outer shell; the space between these shells is obtained by means of wooden core



DETAILS OF CONCRETE CHIMNEY AT ELIZABETHPORT, N. J.



PLAN AND ELEVATION OF THE MOLD

blocks. Scaffolding is erected inside of the mold; on this scaffolding the hoisting beams, *A*, shown in Fig. 2, are supported.

Material.	No. of twists per foot.	Per cent of gain.	No. of twists per foot.	Per cent of gain.
¾ inch square commercial iron	⅜	0.03	¾	0.05
" " " "	1½	0.17	2¼	0.18
" " " "	3¾	0.20	6	0.24
¾ " " Norway "	...	....	6	0.53

After the first filling of concrete in the mold is thoroughly set, the turnbuckles on the mold are let out, leaving the mold free to be raised by means of the threaded stays and hand wheels. Eight men are required to raise the mold, one man at each wheel. The mold is raised 5 feet at a time, this leaving the mold a lap of 7 feet on the portion of the chimney already set. The mold is now tightened up by means of the turnbuckles, and is again filled with concrete and iron rings. Perpendicular iron rods are also placed through the chimney, as shown in Fig. 1. These are joined at every filling, making a series of continuous bars from the base to the top of the chimney. The operation is continued each succeeding day, the scaffolding being extended upward, and the mold raised, filled and the concrete allowed to set; thus 5 feet of the chimney is completed each day. When the mold is raised high enough to clear the cleaning-out door, the concrete is delivered to the men on the scaffolding by means of a bucket-hoist inside of the mold. In molding the cap, a plaster mold is used.

The outside finish of these chimneys may be left plain, or tooled to represent stone; sometimes, to add to a chimney's appearance, two rows of concrete brick are laid in place after each day's work, this making a series of brick rings 5 feet apart throughout the height of the chimney. When lightning rods are desired, the perpendicular rods already referred to are extended up through the cap.—*Scientific American.*

CEMENT PAVERS TOOLS.

The Orr & Lockett Hardware Co. of Chicago, Ill., are the largest dealers in cement pavers tools in the United States. We take pleasure in recommending this company to the trade. We herewith illustrate an in-

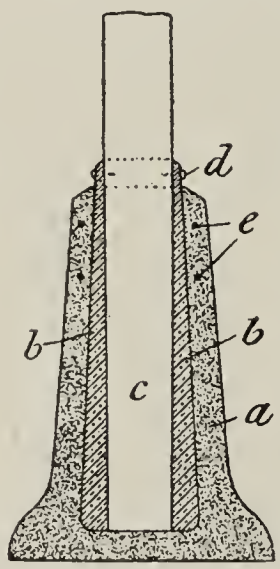
dentation roller manufactured by them. All of their tools are strictly first-class and of the latest design. Cement pavers tool catalogue will be furnished by addressing the firm.

A Dallas company has leased the asphalt mine located at Burnet, Tex., and has a force of men at work now developing it. There seems to be plenty of asphalt from surface indications.

The City of Springfield, O., is advertising for bids on a large quantity of cement sidewalk work and combined curb and gutter. Bids must be in June 13th. Address R. N. Lantz, city clerk.

CONCRETE SOCKET FOR TELEGRAPH POLE.

Carl Potsch of Germany has secured patents for Germany on a concrete and wood casing for telegraph poles as shown in the illustration, in which C is the pole, B the wooden sectional casing, D are screws which fasten the wooden casing to the pole, A is the concrete enveloping the wooden casing and pole, E are iron rings imbedded in the concrete. D. R. patent No. 114,427. The object of the invention is to protect the pole from the moisture of the earth and to give it greater stability.



J. G. Tennant, traveling freight agent of the Nickel Plate Railway, is locating marl beds along the right of way of the railway he represents, with the view of promoting the Portland cement industry on the Nickel Plate.

The American Cement Post Co. of Athens, Mich., has finished its 40-ft. extension on the north end of the old planing mill and begun the erection of another extension of 120 feet on the south end. The building will be 220 feet in length when completed.

ST. LOUIS WORLD'S FAIR SUGGESTION.

CONCRETE CONSTRUCTION.

Joseph Paxton, gardener to the Duke of Devonshire, sketched in the rough an idea for a great World's Fair building, the Crystal Palace of London, on blotting paper. He carried it away with him and worked out the details and in ten days his drawings were complete and estimates made. The royal commissioners had already reached preliminary decision on plans. They were meeting in London. Paxton started to the city to submit his ideas. On the way he saw Robert Stephenson, one of the world's chief engineers and a commissioner. Stephenson studied the papers some minutes and put them down. Looking at Paxton, he said: "Wonderful! A thousand times better than anything brought before us. What a pity they were not prepared earlier? Will you lay them before the royal commissioners?"

And he did. The plans were referred to the building committee and rejected. The gardener took his idea to the newspapers, and woodcuts brought out the beauties of the conception. He appealed to the public against the royal commissioners.

"Never," said Dickens' *Household Words*, "was an appeal more promptly and satisfactorily answered. The practicability, simplicity and beauty of the scheme convinced every member of the many-headed court of appeal."

Public sentiment forced the royal commissioners to reverse their action. Paxton's plan was adopted. Such was the genesis of the far-famed Crystal Palace.

Out of the widest range of suggestion and the utmost freedom of discussion will come, perhaps from unprofessional and unexpected source, that which shall make the Louisiana Purchase Exposition truly wonderful and some part of it enduring.

"In strength and durability no masonry, however hard the stone or large the blocks, could ever equal these Roman walls of concrete, for each wall was one perfect coherent mass, and could only be destroyed by a laborious process, like that of quarrying hard stone from its native bed."

So says the Encyclopedia Brittanica, furnishing a text for a suggestion on World's Fair construction. The desire that some part of the Louisiana Purchase Exposition shall live goes without saying. In the growing and improving use of concrete seems to be presented to St. Louis an opportunity. The walls of such construction as it may be decided to make permanent may be reared at from one-fifth to one-third the cost of

stone or brick. The columns, the arches, the figures and the decorations may be produced at one-tenth the cost of carved stone. And the walls will defy time, while the ornamental portions will remain in perfect preservation. Better than of granite will be a World's Fair building of concrete. Into an "art palace" of heavy exterior and gloomy halls and corridors Chicago put $1,500,000. There is little impressive, but a sense of massiveness in the structure. For $500,000 St. Louis may have in concrete a more lasting and more beautiful structure to survive the Fair and to be devoted to art purposes. With $1,000,000, or at the most $1,500,000, St. Louis may house for generations a collection of the wonderful and interesting things which will be brought to the Fair and left with the assurance of proper care and protection. With $1,000,000 or $1,500,000 it is possible to create not for six months, but for decades, illustrative construction that shall be educational, outside and in, an original feature of the Fair and a place to visit and study hereafter.

Concrete construction at St. Augustine, Fla., is the wonder of Northern visitors. Franklin W. Smith tells how it all came about:

"In the winter of 1882, while in Spain, I decided to build a winter home in St. Augustine, after the model which the experience of centuries had proven desirable in semi-tropical countries.

"An oriental house of wood would be an anachronism; yet there was no stone in Florida. To freight it from the North would be an extravagance. At Vevay, on Lake Geneva, subsequently, the dilemma of material was relieved. In the neighborhood a chateau was in construction. Concrete partition walls 4 inches thick were being cast of the rubbish, bricks, etc., left from the main walls, in a wooden boxing. Nearby Grecian balusters were being cast of fine sand and cement in iron molds, very rapidly, with unskilled and cheap labor. The problem was solved. I saw henceforth an age of stone for St. Augustine, instead of pitch-pine.

"In the following December, with a Boston mason, experiments were made, and the first concrete blocks of coquina sand and Portland cement were cast in St. Augustine for the Villa Zorayda. They are preserved as valuable relics. Then the first course around the line of the dwelling was laid in planks 10 inches high filled with the mixture. In two days a range of handsome smooth stone was revealed. It was followed by another immediately, and these layers hardened sufficiently to allow the raising of the walls a course every other day. The partition walls were cast with the main walls in even courses, also, the arches of the court, so that the building is practically a monolith. Arches were reinforced and anchored to the walls by round iron rods. The outer walls were cored with an air-chamber, by a board buried in the boxing and then raised, like a boat's centerboard, before the concrete hardened. In thirty days the walls were as hard as any building-stone, and in a year as defiant of a drill as granite.

"The result is a building that can hardly be excelled for durability, solidity and richness in effect, dryness and fireproof qualities. Fireplaces cast in concrete have withstood to this time the winter fires of live-oak wood, without as much impression as would have been made upon fire-brick.

"The famous and extensive constructions in concrete in St. Augustine followed, and now it is in universal use, not only for first-class and rich buildings, but for fence-posts, sidewalks, chimney flues, etc., and for the piers beneath the poor man's cottage, formerly built of bricks from the North at twice the cost. The Casa-Monica stands as a superb illustration of concrete. A facade of above 400 feet, a tower of 100 feet in height, balconies, arches, cornices, battlements, etc., are a homogeneous mass of solid and elegant stone. It was a new departure in this building to use the sea sand simply dredged from the flats of the harbor. It was found that the finer the material the more dense and uniform in color the result. The building challenges comparison with any in the United States for the desiderata of a first-class stone construction, and especially with its ornamentation and impressive grandeur, illustrating the Spanish castellated and the Hispano-Moorish forms."

This introduction of the use of concrete at St. Augustine by Mr. Smith gave Mr. Flagler the idea for his Florida investment for $2,000,000. Professional architects visiting St. Augustine marveled at the perfection of the lines in the Villa Zorayda. Mr. Smith told them that he had simply and accurately preserved the lines and proportions of the best Moorish architecture he found in Spain, and had made his molds to correspond.

"This material can claim no patent right," says Mr. Smith. "It is as old as Roman construction and long familiar in our country in coarse work. But its use for fine details with a purpose of utmost endurance has slight precedent previous to its introduction in St. Augustine."

In demonstrating the economical possibilities of concrete Mr. Smith has estimated that it can be put into walls for about one-half the cost of brickwork in Washington, say $6 per cubic yard. In comparison with cut stone or marble the advantage of concrete is much more striking. But when it comes to the ornamental features of construction the saving by the use of concrete is a matter for marvel.

The marble columns at the capitol are a few inches over 30 feet in height. They cost about three thousand dollars each. After the first expense of the mold, Mr. Smith says, these columns could be turned out of concrete for $100 each.

A church recently completed in Brooklyn affords one of the best illustrations of concrete construction. From foundation to turret it is built up of this mixture of cement and sand. Yet as the successive courses of the soft material were put in the wooden troughs were so arranged with strips as to give the appearance of jointed blocks of cut stone. Cold twisted steel rods running through the concrete add to its strength. Not only are the walls solid concrete, but the ornamental work as well. The ornamental parts were cast on the ground in plaster. Even the gargoyles apparently carved with great and artistic labor from stone, were made of this concrete, poured into a mold with a steel rod running from end to end. With a chisel the outer surface of the walls, while the concrete was still tender, have been gone over, giving the rough stone effect, while the ornamental parts have been left as they came, clean and sharp, from the mold. The church is 80 feet front by 139 feet depth. It has a tower 80 feet high. Not far distant is a church built of natural stone. In beauty of architecture and in ornamentation the concrete church far surpasses the stone. It cost one-third as much. In durability the comparison is altogether in favor of the concrete.

Philadelphia has pioneered the way in concrete bridge-building, so far as the United States is concerned. In 1893 a two-arch bridge was built over Pennypack Creek. Mr. Souder, the engineer in charge of the 300 bridges of Philadelphia, says this first concrete bridge "has given eminent satisfaction, not having cost a cent for repairs since finished. Philadelphia has seven concrete bridges and three more under consideration. One of the new projects will have a span of 75 feet. Ordinary road bridges covering culverts of considerable size are made entirely of concrete, with side walls and floor of the same and all approaches at cost varying from twenty-one hundred to twenty-three hundred dollars. The

saving over this expense of repair of wood and stone and steel is so notable that Philadelphia will probably adopt the concrete to the exclusion of the other forms for highway purposes.

At Mineola, on Long Island, a court-house 95 feet front by 175 feet, 36 feet from the ground to the roof and with a dome 65 feet high, has been built. Foundation, walls, floors, pillars, partitions and dome are of concrete, with cold-twisted steel bars embedded.

At New Brighton, on Staten Island, is one of the curiosities of American architecture. It is known as "Cement House." Present interest lies in the fact that this is an exhibit of the time-defying quality of concrete construction. Cement House was built in 1837. It is in perfect preservation so far as the walls are concerned. The concrete was cast in solid blocks with wooden molds. When the blocks had hardened they were put in the walls, like so many stones. Concrete construction of today is on an altogether different plan. Now the concrete is put into the wall where it is to stay. The walls are built up in courses between the retaining molds.

In California the manufacture of concrete pipes for irrigating systems has reached large proportions. Pipes from 8 to 12 inches inside diameter are made for lateral branches. Those for main lines are from 2 to 3 feet inside diameter. The thickness of these pipes is from 1 inch for 8-inch to 3 inches for the 3 foot size.

The proportions of the materials used are one part of cement to three or four parts of sand and gravel. The sand must be clean and sharp, not too fine. The gravel must be clean, with no pebbles larger than 1¼ inches. It will not do to guess. Cement and sand and gravel should be measured in cubic foot measures, the top to be struck off after each filling. The cement and gravel and sand must be put in a water-tight mortar-box as measured and must be worked over twice while dry. This is to fill the spaces between the pebbles and particles uniformly with cement. Water is added through a hose-sprinkler until the mass is well moistened. Then the concrete should be deposited quickly in the molds by one man while another tamps it solidly with an iron bar. Care must be taken not to wet more mortar than can be used before the first "set" of the mortar occurs. Excess of water is to be avoided. W. B. S.

The Peninsular Portland Cement Co. made its first shipment of cement on the 5th inst. The works are running only three of its six rotaries.

STEEL AND CEMENT HIGHWAY BRIDGE DESIGNS.

MELBER SYSTEM.

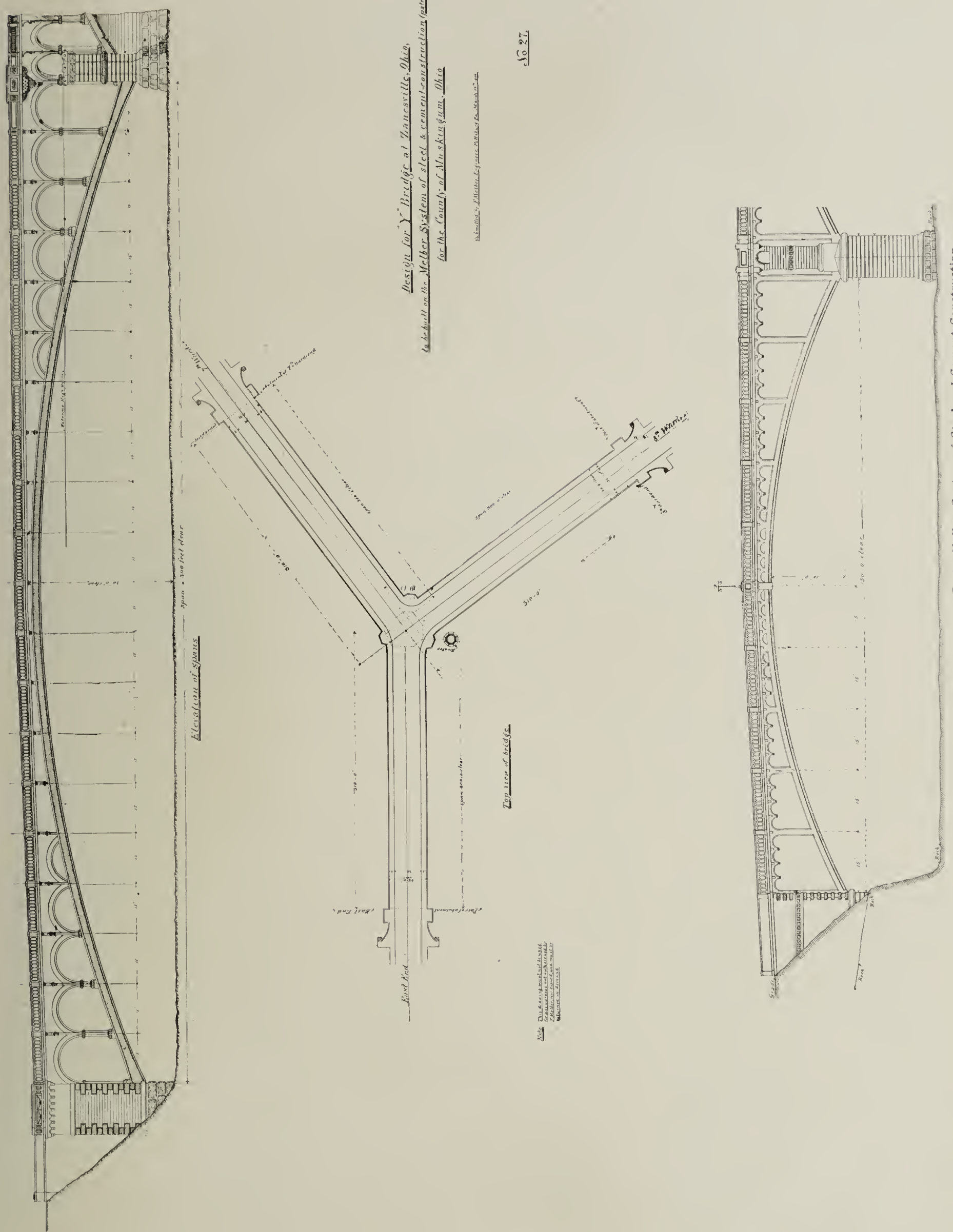
The illustrations show two different steel and cement mortar highway bridge designs for the commissioners of Muskingum county at Zanesville, O. The 300-foot span was calculated as an arch with fixed ends, similar to the 300-foot span designed by the writer for the Des Moines river bridge in 1898. The 150-foot spans are figured on the three hinge joint principle, as shown by the strain sheet attached in both designs. The floor is supported by posts (hollow walls properly reinforced where high water might be encountered) which rest on the arch.

In the case of the 300-foot span the space between posts is open intended to let high water pass freely next to abutments, while in the case of the 150-foot spans that space has been closed. As to the question of practicability of real long spans in steel and cement on my system which might arise in the mind of some not thoroughly in touch with the subject I would say, referring in this connection to a short article of mine published in the September, 1900, issue of this paper—on page 42—that that my system affords the use of a section of arch differing from the rectangular form as generally used to-day, I can use either a series of I-beam, channel or box girder-shapes or a combination of them for my main carrying arch, taking care of the calculated shearing strains which produce, i. e., are the cause of the horizontal tension or compression fiber strains as set forth and claimed by me in my patents.

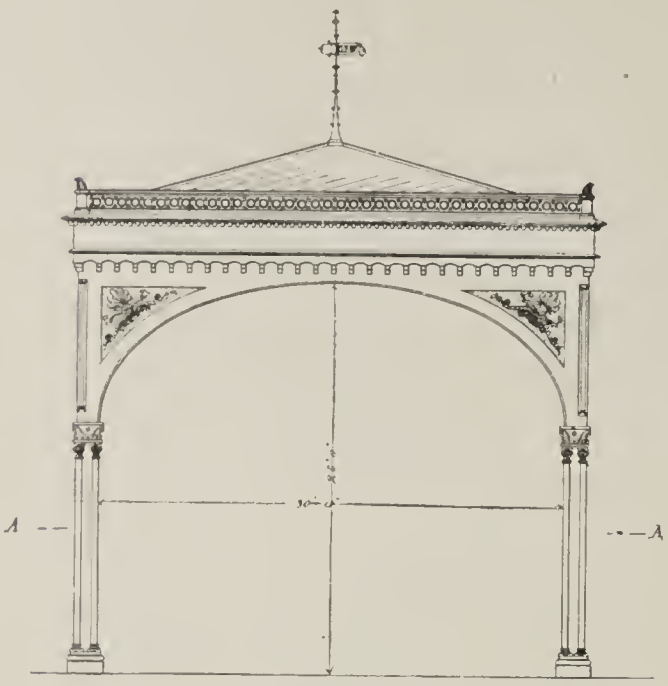
In bridge arches with rectangular section you will, in figuring the depth or thickness of the arch with a given fiber strain, bending moment and axial compression, always have a considerable tension area left, which demands the use of steel absolute. Working under the same assumptions I also have the allowed fiber strain in compression with my shapes, but I have all tension eliminated, that is I let the tension fiber strains be cancelled by the equal amount of axial compression so I do not need any steel at all to take care of any tension in the mortar and more than this, I find that I need only a fraction of the section or weight of the rectangular shape. Herein lies the main secret why long spans in steel and cement are practicable but we will find some more points bearing on this subject farther below. With the proper application of these economic principles in conjunction with what I said in a former issue of this paper, you will be surprised to find that for large spans the difference in weight between the structures in steel and cement on my system and "*all-steel*" spans is not near as great as many think. The crushing strength of steel to that of 1 : 3 Portland cement mortar properly prepared is as 16 to 1, and for compression members where buckling formulæ take effect in calculations of steel members the ratio may come down as low and lower than 10 to 1, while the proportion with regard to the weight is as 4 to 1 in favor of the mortar, which I find to weigh about 120 pounds per cubic foot. The advantages in strength which steel has of tested specimens, dwindle down quite rapidly when it comes to the manufacture of the finished bridge, for while every pound almost of the cement mortar used does its share of duty, the same can certainly not be said of the steel and this feature combined with the much greater weight (fourfold) of the steel has an equalizing effect on both kinds of bridges. Not only is there considerable loss of effective steel area in tension members from necessary punching and an increase from added steel to make good this loss all over the bridge, but there are many secondary constructions which add nothing to the effective steel area needed (net area), such as struts, rods, braces, rivets, lattice bars, tie plates, bearing plates, pin plates, pins, bolts, etc., etc.; this extra weight of trimmings increases more in proportion as the spans increase. In my steel and cement construction every pound is effective. The buckle plate and paved floors are likewise heavier than the combined steel and cement floors which need scarcely more than a wearing surface to make the roadway complete.

In erecting such work I avail myself of the facilities afforded by the use of my patented steel and cement joints. The work will be delivered hard, tool dressed, hoisted in place, lined up and joints floated out, thus producing a piece of work as solid as if cast in one piece. The work can be done in all seasons, the danger of deformation of arch by onesided casting is obviated, work may begin at as many places as desired and work on the single concrete sections can begin with or before the excavation and will have plenty time to harden enough to be lifted in position.

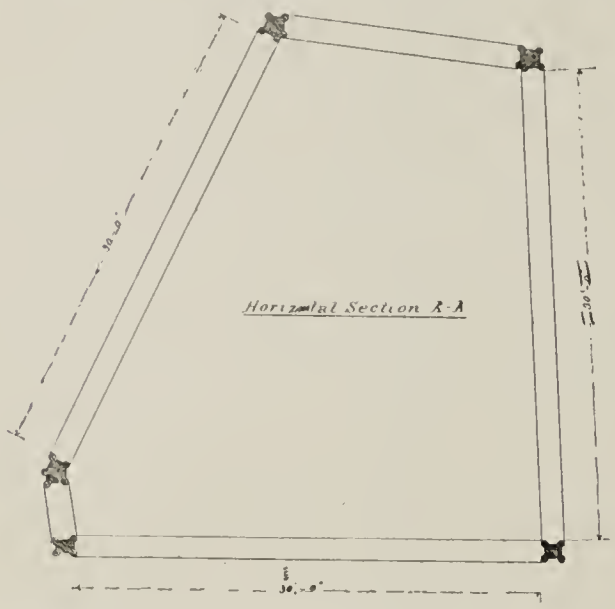
There is no reason that what applies to the construction of bridges should not apply as well to buildings. Our high office buildings, where the steel skeleton is doing the carrying and the bracing although found indispensable in the bridge is here omitted although the strains from wind, etc., are very considerable, will not only be stronger in every way,



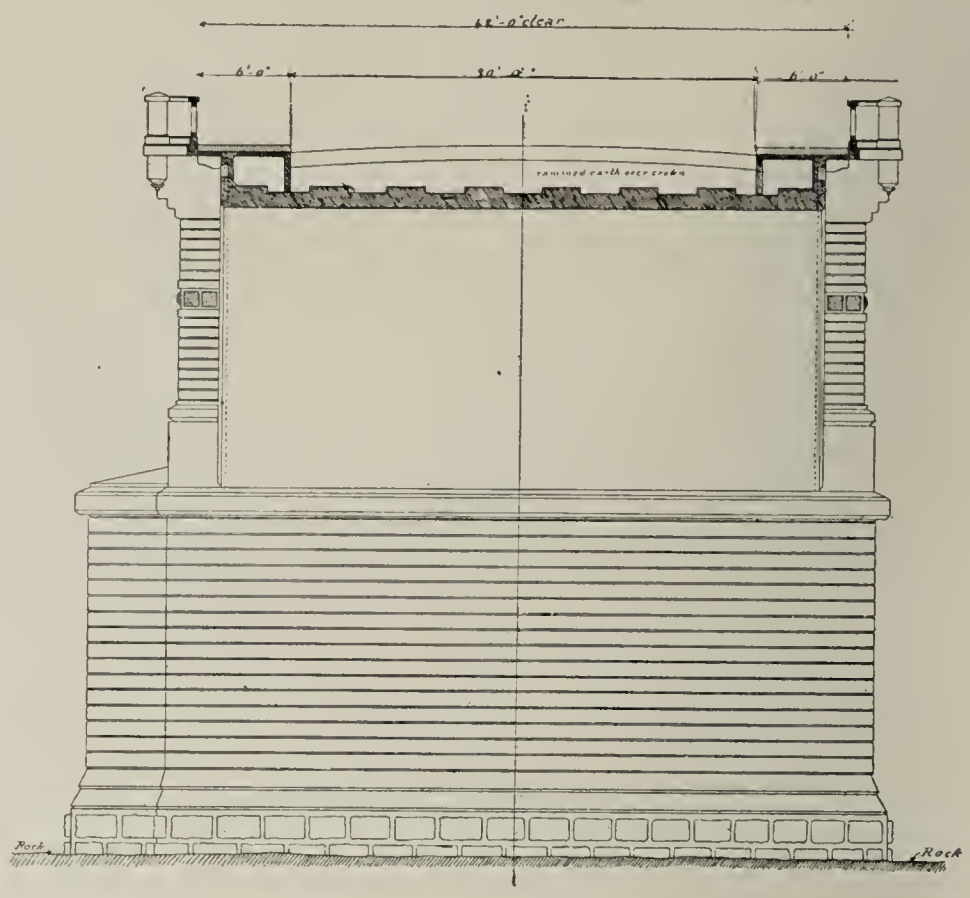
One of the Six Equal Spans—One Hundred and Fifty Feet Each—Melber System of Steel and Cement Construction.

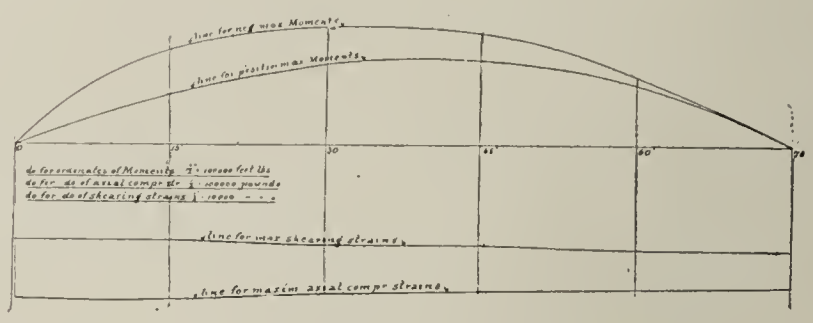


Front Elevation (50m on each prong)

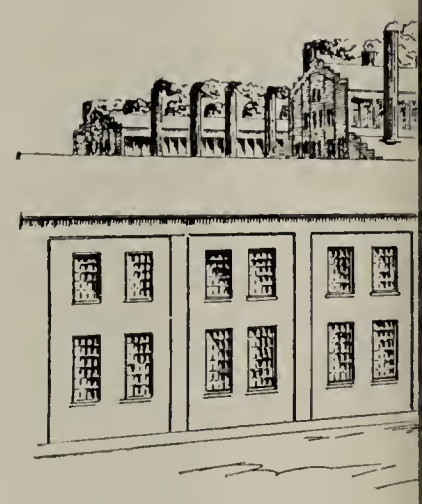


Elevation of pier & cross section B-B





Strain diagram for ½ arch, loaded 5 feet of width.



The above cut shows part of the

every square inch acting as a bracing if built on this steel and cement system, they will also be much lighter and with the proper materials and tool dressed can satisfy all demands an architect may make on a fine cut stone structure, and if the sections are arranged in proper order and story heights and all systematically managed the work can be done faster and cheaper than at present.

F. MELBER,
Civil and Mechanical Engineer,
P. O. Box 465, Pittsburg, Pa.

The Farwell Portland Cement Co., capital $350,000, has been organized with the following officers: President, J. L. Littlefield; vice-president, Geo. W. Graham; secretary, W. C. Fuller; treasurer, T. F. Bingham. The plant will be located in the village of Farwell, Mich.

The Hecla Cement & Coal Co., recently organized by Detroit and local capitalists, with a capital of $5,000,000, has purchased a site of 135 acres on the river front. The site is a part of a tract of land recently set outside of West Bay City for the purpose of inducing factories to locate there without being obliged to pay burdensome city taxes. The company will commence the erection of a plant in a short time.

Incorporated: Garrison Coal, Lime & Cement Co., capital stock, $40,000; object, manufacturing; principal office, 122 California avenue, North Atlantic City, N. J.

The bids for an arch culvert over Eighteen-Mile Creek at Lockport, N. Y., ranged from $11,000 to $18,500 for stone and $8,469 for concrete. The Sherrill Contracting Co. made the bid for concrete. The taxpayers are to decide between concrete and stone. The Sherrill Contracting Co. is now erecting a four-story cold-storage plant for Moody & Son at Lockport; all walls are being constructed of concrete.

The floors of the new Inter-Ocean building on Monroe street near Dearborn street, Chicago, are constructed of concrete, Roebling system, and were put in during the cold weather in January of the present year, the entire work being exposed to the open sky and was frozen for several weeks. The floors were tested March 30th and were found perfect, showing that the freezing of the concrete had no injurious effect on the work. The concrete was composed of 1 part of Portland cement, 2½ parts sharp sand and 6 parts cinders. Marquette and Vulcanite Portland cement was used in the work.

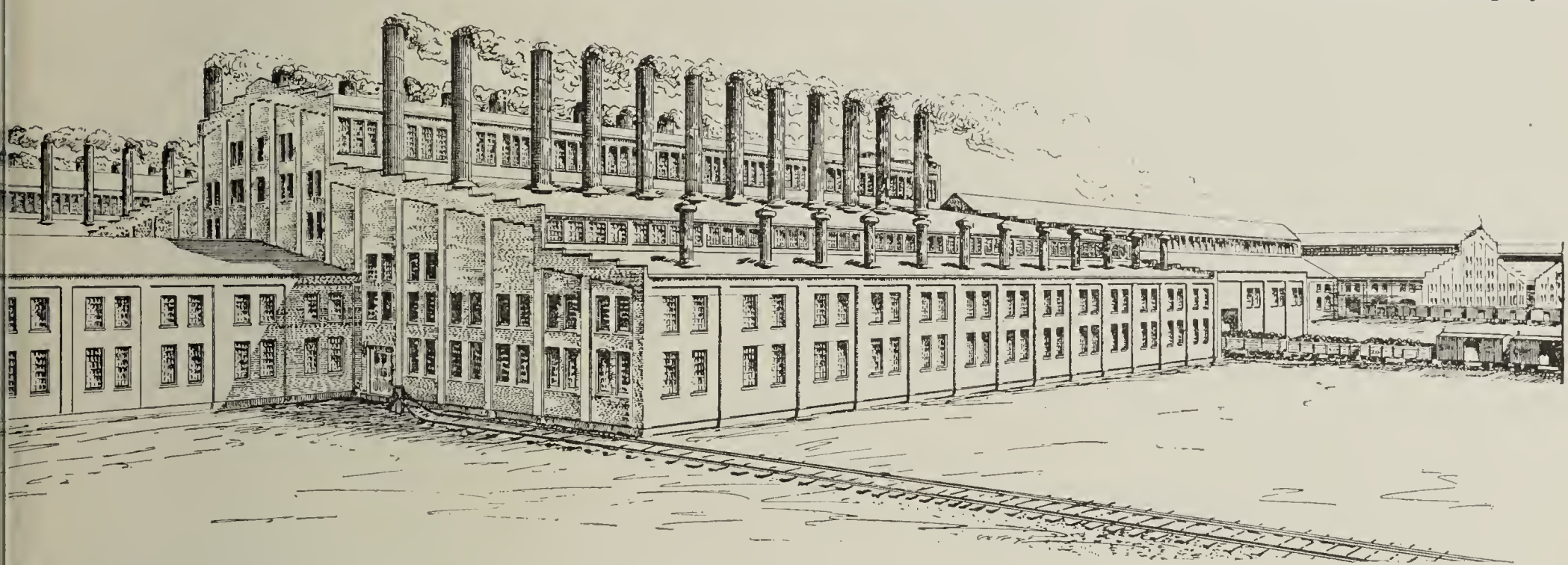
The Newaygo Portland Cement Co. is about ready to market its cement.

Texas Portland Cement & Lime Co. of Galveston, Tex.; capital stock, $200,000. Incorporated by Joseph Levy, R. Waverly Smith, Joseph Nussbaum, M. Moore, James T. Taylor and J. Clark.

At Charlestown, Ind., the Standard cement mills have shut down, with their warehouses full. At Sellersburg, where two large plants of the cement trust are located, but two small mills are in operation. Only a few of the smaller concerns in the county are running. The Indiana Cement Co. recently sold the right to produce its quota to the trust, causing a loss of $300 a week to their employes here. The suspension of operations is said to be due to building having been overdone in recent years and the preference for Portland cement in many lines of construction work.

C. W. STEVENS' NEW PROCESS ARTIFICIAL STONE.

The inventor of Cast Portland cement stone has been engaged continuously in the manufacture of artificial building stone for 27 years, commencing with the Freer Artificial Stone Works at Jackson, Mich. In 1877 he established the Lansing (Mich.) Artificial Stone Works, which he operated up to 1891 producing either the trimmings or the entire stone for over 1,000 buildings in Michigan and Illinois. Up to a few years ago the artificial stone produced by Mr. Stevens was either tamped or pressed. By his new process no tamping or pressing is required, yet the new process stone comes out with cleaner and sharper lines, even the feather edges on imitation carved work are as solid as the body of the plain flat surfaces and resemble in finish and texture any natural lime or sand stone which has been tooled by hand, at the same time the stone produced is entirely free from laminations or other imperfections and is not liable to hair or expansion cracks so common in tamped or pressed artificial stone work. These results have been obtained by abandoning the old set rules laid down by cement experts and by adopting an entirely new principle. This new process stone is meeting with the unqualified endorsement of Chicago architects and is now going into many of the finest buildings in Chicago, following the most elaborate original designs of architects' drawings at a minimum of cost for the patterns. The finished stone can be produced either plain or in imitation of elaborate cut stone. All of the business blocks in Harvey, Ill., where the Stevens Cast Stone Works are located, are either trimmed or entirely constructed of the Stevens stone dating from the establishment of the works there. Harvey therefore contains fine specimens of the old and new style artificial stone. The editor of this journal saw specimens of both and noticed that the new process stone stood out in strong contrast for beauty and handsome finish when compared with the old process stone. The finish and texture of the new process stone is superior to natural stone and will be equally durable. A large union school building is one of the fine structures erected out of the Stevens stone. Mr. Stevens organized a stock company which has a large factory in operation at Harvey, 360x40 feet, full of orders for Chicago buildings. Mr. Stevens is giving his entire time introducing his new process stone in the United States. The Great Northern Portland Cement Company's works —illustrated above—have adopted the Stevens stone for the first 4,000 barrel unit of its plant now under construction at Baldwin, Mich. Mr. Stevens says the new process cast stone is the result of 27 years continuous experience in the manufacture of artificial building stone. Parties desiring further information or catalogues can address C. W. Stevens, Room 808, 100 Washington street, Chicago, Ill.



THE FIRST FOUR THOUSAND-BARREL UNIT OF THE GREAT NORTHERN CEMENT COMPANY, AT BALDWIN, MICHIGAN.
ildings being erected by the Great Northern Portland Cement Company. The walls are built entirely of the Stevens' Cast Stone on which patents have been allowed.

Incorporated: Pacific Portland Cement Co., San Francisco, Cal. Directors: S. Murfee, N. S. Bell, J. T. Kilby, M. Kind, G. Stone. Capital, $500,000. Subscribed, $500.

Marksboro Portland Cement Co.; capital $400,000; manufacture Portland cement. Incorporators: Andrew C. Snyder, Philip Scanlon, both of Newark, N. J.; H. V. H. Snyder of Paterson, N. J.; Southard & Fairchild, attorneys, New York.

THE LAW AND STRIKES IN GERMANY.

The supreme court of the German Empire has just handed down a decision against twenty striking foundry employes, on the following statement of facts. The plaintiff owned and operated a foundry; certain patterns were received from a neighboring foundry, where a strike was on. The plaintiff's twenty employes refused to work on these patterns out of sympathy for the strikers, but expressed a willingness to work on any other patterns. The plaintiff thereupon discharged his men and commenced suit for damages against them. The court found for the plaintiff, assessing the plaintiff's damages at 2,043.76 marks ($486.00), holding the defendants jointly and severally liable for the payment of the same. The court held that the plaintiff was justified in discharging his employes after they had refused to execute his orders in the line of their employment. That the law did not require the employer to yield to the unlawful demand of his employes, otherwise the orderly management of his business would become untenable.

That the acts of the defendants resulted in the premature dissolution of the existing contract relations through their own fault and must be held responsible for any damages the plaintiff has suffered. That the defendants acted in premature concert, with the intent, by their united strength, to compel their employer to do that which they could not have done singly, knowing that the plaintiff would be injured by such action and thereby accomplish a malicious purpose common to all, therefore, the defendants are held jointly and separately for the entire damage resulting from their acts.

Cement and Engineering News $2 per annum.

PORTLAND CEMENT.

An instructive talk on "Essential qualities required in specifications for cement," was the feature of a recent meeting of the Engineers' Club of Toronto. M. J. Butler, C. E., chief engineer for M. J. Haney, C. E., formerly with the Rathbun Portland Cement Works, Deseronto, Ont., led the discussion. In his statement of the proper requirements in specifications for cement Mr. Butler said that although for the past twenty years, papers by experts dealing with this have appeared, much still remains to be said and done before a perfect specification will be had. In the hope of assisting to throw some little light upon the questions, he ventured to submit the scheme outlined below; believing that such a division substantially includes all that it is needful to know about a cement in order to confidently use it on any work. Much of existing requirements found in Portland cement specifications and text-books is due to the fact that all of our accumulated data is based on English sources, where coarse grinding and unscientific raw mixtures are the rule. The clause requiring a considerable increase in strength between say 7 and 28 days was framed by the late Henry Faija, and was no doubt a good one, having in view the coarsely ground cement then in use. The fixing of a rather low tensile strength at the earlier period was a simple recognition of a state of existing facts. Now that cement is so finely ground, and hence in a condition to reach an active state almost at once, he failed to see why any engineer should object to a high tensile strength at an early period. If we can secure 90 per cent of the strength in one month, why object to it? The following table shows the chemical composition generally considered to be requisite for a good Portland cement:

Lime (calcium oxide)	58 to 65%
Silica	20 to 26%
Alumina	7 to 14%
Magnesia	1 to 3%
Akalies	traces to 3%
Sulphuric acid	traces to 3%

SCHEME FOR PORTLAND CEMENT EXAMINATION.

1. Form and fineness of grain.
2. Color and specific gravity.
3. Time of setting.
4. Hardening.
5. Strength.
6. Constancy of volume.
7. Hair cracks and shrinkage cracks.
8. Behavior under extreme heat and cold.
9. Additions and adulterations.

(1) Under the microscope the grains of a well made Portland cement are flaky, of a thin leaf-like scaly structure, and this form seems to be required to secure that close adherence so characteristic of good cements. Fineness is one of the most valuable characteristic qualities a cement can possess. The fact is that in order to be active it is essential that it be fine. To any of you, familiar with chemical work, it will be obvious, that, in order to secure results, the first preliminary is to reduce the material under examination to a minute degree of sub-division in order that the re-agent may take hold of the substance. So in making a mortar, the chemical forces at work are influenced by the fineness of the active material, viz., the cement. When sifted through a sieve of 10,000 holes to the square inch the residue should not exceed 10 per cent, and when through the 40,000 sieve the residue should not exceed 15 to 20 per cent in the case of Portland cement. In the case of sand cements the fineness should be on 10,000 sieve not to exceed 5 per cent residue, and of the 40,000 sieve not to exceed 10 to 15 per cent. The finer the grinding the better.

(2) Color.—The color of a good Portland cement is ordinarily of a greenish gray, but brownish spots are not necessarily due to under burnt material. It may be due to overburnt clinkers burned with too much sulphur in the coal. The rotary kiln produces a peculiarly dark, greenish glistening clinker. The old-fashioned bottle kiln, using coke for fuel, produces the color which finds a place in all the text-books and in most specifications in use in this country. The continuous burning type of kiln illustrated by the Dietzsh & Aalborg, using coal for fuel, do not produce a clinker of the same color, although the resulting cement is chemically and mechanically alike, hence upon the manner in which the clinker is burned will depend, within limits, the color of the resulting cement.

The specific gravity when accurately and thoroughly taken is a valuable test indicating the proper density of the cement. It may vary in fresh Portland cements from 3.08 to 3.25, and ordinarily should be about 3.10. The determination is one requiring care and skill in order to secure results of value. Old cements invariably show a lowering of the specific gravity.

(3) Slow setting cements are, for general work, the safer and more reliable, a quick setting cement is apt to be a dangerous one; three to four hours for the initial set, and six to eight for final set will ordinarily suit most works, freshly ground cements will always set more quickly than those in store for some time, hence there is apt to be some unhydrated calcium oxide in quick setting Portland.

(4) Hardening should not be confused with setting, as it begins when the latter leaves off. For proper hardening the work should be left undisturbed, and with plenty of water; drying out quickly often ruins a good piece of concrete; so too a senseless picking at new work, a fault often witnessed. Leave it alone a reasonable time with sufficient moisture to allow the chemical action to go on. Good work will continue to harden for a whole year.

(5) The custom has grown up to test cement purely in tension, although good reasons might be shown why it is preferable to test in compression. The ease and certainty with which tensile tests can be made probably account for the selection of this form. Transverse tests are more difficult to carry on as a slight flaw in the sample unduly affects the result. A good Portland cement when tested neat, should at the end of 7 days, 1 in air, 6 in water, show a tensile breaking strain of not less than 450 pounds and at the end of 28 days not less than 600 pounds to the square inch. A sand mortar test is, however, a much more practical one and shows better the real value of a cement. Standard sand (crushed quartz sifted through a 400 sieve, and using what remains on a 900 sieve), should be used for comparative purposes. It is hard enough to get comparative results with different brands of cement without introducing the additional complexity of varying sands—hence the necessity for a uniform quality of sand. It is by no means a strong mortar. As to secure the best mortar, a varying size of grain in the sand is what is required, he was led to enlarge somewhat upon this point, as twice or three times during the past year he found engineers specifying that the sand to be used on large works should be of such a grain that all the materials should pass the 400 sieve (20x20), and use only that retained by the 900 (30x30) sieve. No doubt, finding standard sand specified for comparative purposes in committee reports in testing cement, and failing to appreciate the purpose in view, they have concluded that such sand must be the best. Well, it is not; ordinary pit sand will make a much stronger mortar.

(6) This test is in Mr. Butler's judgment at once the most practical, easiest to carry out and most valuable in the list, but requires to be carefully done. He ventured to submit the following directions: 1st. Select a small strip of plain glass, about 3-in. by 1½-in.; wash it clean; mix the cement neat, working it up into a stiff mortar, trowelling it well on the glass, the briquette will be about half an inch high in the center and be worked off to a knife edge at the edges of the glass, forming a flattened pyramid. All the air should be

worked out with the trowel, and all surplus water. Spend time enough to do the work well. Cover with a damp cloth to preserve the sample from drying out; leave in the air until set, generally 12 hours; then place in a damp atmosphere or vapor over hot water in the hot bath tank—water heated to 130° F., where it should remain for 12 hours longer. Then place in the hot water and steam it for 24 to 36 hours. If a new untried cement raise the temperature gradually up to 170° F. If the sample remains true and straight and free from cracks there is no free lime present, in a form that will injure the cement or mortar. Sometimes it is found that although the sample is hard, strong and breaks with a sharp ring as it should, that it breaks the glass —and an explanation was asked as to why this should be. The following solution is suggested: The sample generally is lying around for sometime exposed to varying temperatures, the chances are the glass is a very hard piece, and one slightly porous and roughened, so that the briquette adheres very strongly to it. Now the co-efficient of lineal expansion of pure Portland cement is for one degree Fahrenheit in a length of one, 0.00000594, and for glass of the kind above assumed, 0.00000397 in other words, and neglecting the cubical effect of the greater mass of concrete—the expansion of the concrete for a given change of temperature is probably twice that of the glass. This explanation also suggests the reason why sound cements quite frequently leave the glass altogether. Care should be taken in examining briquette to distinguish between expansion cracks due to free lime and those sometimes witnessed due to mere drying out, or insufficient trowelling.

(7) Hair Cracks and Shrinkage Cracks.—Portland cement mortar exposed to air diminishes in volume. If drying takes place gradually no defects will appear, but if allowed to dry rapidly, or in a draught of air, or in sunshine without taking the precaution to keep it moist the so-called shrinkage crack appears. Hair cracks as seen on pavements and piers are generally, if not always, due to using too rich a mortar, and are caused as above described. The remedy is use more sand for such surface work.

(8) Under ordinary temperatures cement is unaffected to any appreciable degree; a good cement will stand boiling water; but in extreme cold chemical action is suspended, but between the freezing point of mortar and say a temperature of 400 to 500° F., cement mortar will behave in the ordinary way—higher temperature accelerating the set of the mortar, lower temperature retarding it. At extreme high temperatures he believed Portland cement concrete will disintegrate and fly to pieces, particularly if drenched with water; hence he regarded it as an unsuitable material for fire-proof buildings.

(9) The adulterations usually found are slag and some form of finely ground limestone or rag-stone. He had reason to believe that the exacting of a pearly gray color has had something to do with the adding of such materials. Such adulteration within reasonable limits, if the material is finely ground, is not a detriment to the cement—on the contrary it seems to increase its strength.

C. B. Smith, C. E , formerly assistant professor in McGill University and having charge of the cement testing laboratory there, said they had all listened with interest to Mr. Butler's remarks, as he spoke from an experience and knowledge, both as a manufacturer and user. There were some points that had arisen lately in cement testing which were startling, perhaps alarming, although the future alone could prove this. Regarding specific gravity a demand for a value of 3.10 or over had in the past been considered strict, while now the manufacturers produced a cement by rotary kilns of a specific gravity of 3.25 (when fresh), which according to standard authorities indicated overburnt clinker. Was this true? or did it merely indicate a more thoroughly uniform burning with an absence of underburnt particles? This is a problem that chemists must aid us in solving. Then, also, in neat tensile tests a demand by engineers for 400 pounds per sq. inch in 7 days was met by manufacturers making an article testing 600 to 800 pounds per square inch in 7 days, and practically never getting any stronger, in fact, usually getting weaker in six months or a year. Although sand tests had not indicated any falling off in strength in one year tests, in any that the speaker had ever made, yet this might come later, in several years perhaps. About four years ago, while in charge of the McGill cement laboratory, the speaker had a complete series of samples made, on which to make tests from one week to ten years, and he hoped as years went on to have some long time tests to examine which might give valuable information. Probably the outcome may be to restrict the manufacturer by prescribing maximum as well as minimum tests, in order to prevent the making of a brittle material. The following test the speaker considered was the most important test of all. Soundness is the essential quality. What engineers want to feel is that their works will endure, not for 10 or 20 years, but for hundreds of years, like the structures of earlier days built by engineers, not of an age of so-called "science," but of the dark ages. During the last year he had some comparative tests made in the Toronto City Hall laboratory, which gave the following results:

Name of soundness test.	No. tests.	Failures.	Medium.	Absolutely sound.
Dr. Pruessing's	44	5	11	28
Dr. Michaelis' (boiling)	44	3	6	35
Faija (hot water)	44	2	2	40
German standard (1 month cold water)	44	0	2	42

The first test is a severe one, practically a fire-proofing test, and perhaps it may be asking too much to demand conformity to it but the use or rather abuse of sulphate of lime as a regulator of the time of set, has enabled the manufacturer to conceal the presence of free lime, from even the hot water test, although it may be undeniably present. It remains for users of cement to do one of three things, admit defeat, devise a simple method of making a satisfactory blowing test for soundness or what is probably the most feasible method, regulate the amount of adulteration of sulphuric acid by specification and analysis. Mr. Butler perhaps could tell us whether the use of slack coal as a fuel had contributed appreciably to the amount of sulphuric acid in a cement or not. [Mr. Butler—"It has"]. Because in several analyses which were made of Canadian and American cements this year the percentage of sulphuric acid was high, running up to $2\frac{3}{4}$ per cent (equivalent to say 5 per cent sulphate of lime). This indicates a very unsatisfactory state of affairs. Other noteworthy features of these analyses were that the percentage of CaO only averaged 55 to 62 per cent, and the carbonic acid 2 to 11 per cent, which latter would indicate quite an amount of unburnt clinker or addition of ground limestone after burning. Now, to most engineers, simple tests are the only ones available, and chemical ones may seem not only costly but out of reach, but it is probably the future means of more certain control of the product than any other, and should be more carefully studied and practiced where possible. With reference to frost tests and use in cold weather, while laboratory tests which were made on cold materials exposed at once and left out all winter in Montreal climate gave very good results, equal almost to ordinary laboratory tests; yet in practice difficulties and failures occur. For instance, in Toronto, a concrete abutment laid in frosty but not severe weather scaled off in large patches for say $\frac{1}{4}$-inch deep on portions of abutment laid

with one brand of cement, but with portions laid in similar weather with another brand the surface was smooth and hard. One brand of cement satisfactory in summer for concrete foundations has proven unsatisfactory in cold weather, late in fall, etc. Showing that many little practical features may affect theoretical results deduced from one or two brands of cements only.

In reply to a question regarding the reason for not adopting transverse tests which could undeniably be made with simple machinery, the speaker's experience has been that the strength of specimens was so erratic, being affected by the presence of the least flaw on the tension face of the specimen, as to preclude its usefulness as a method of testing. Tensile strength forms a satisfactory index of compressive strength also, and is made by simple machinery. It is adopted all over the cement testing world, and thus provides a mass of data to base knowledge or specifications upon that could not in any case be easily cast aside, even for a slightly superior method of making tests, which, however, has not yet been discovered. Fineness of grinding is a matter of dollars and cents; a continual advance is being made, but too exacting a specification would restrict competition and defeat the end in view. The manufacturers are alive to the value of fine grinding and are making steady progress. At present 10 per cent residue on No. 10,000 sieve is as fine as any but Canadian or American cements are ordinarily ground, and about fixes the limit of open competition.

R. B. Rogers, of Peterboro, and John Lucas, of Toronto, agreed generally with the deductions of the speakers. The former thought too much stress had been laid on changes in the methods of manufacture. He found the samples tested on the Trent Valley Canal went on increasing in strength for a month, but after two to four years they became weaker.

Mr. Haney questioned whether tests were carried over a sufficient length of time. He found the maximum strength was attained in a short time, but it was to be shown whether deterioration set in after that.

E. J. Philip asked if cement would set when it had frozen.

Mr. Butler—No.

Mr. Philip understood that at Sault Ste. Marie concrete and cement work was carried on all winter, the only precaution taken being that it was kept from the sun. He had some work built in Toronto in winter, and all the provision made was to see that frost did not get at it during the first few hours. Afterwards it froze without any apparent harm.

Mr. Butler said salt was often added in cold weather to lower the freezing. In reply to Mr. Philip he said water containing clay in solution often spoiled the setting of cement.

The president said that generally speaking it was a mistake to lay cement in very cold weather, yet he had often done it with good results.

Mr. Haney said that when mortar was frozen continuously till it dried there was no harm from frost, but the damage was done by alternate freezing and thawing. With regard to sand it must be remembered that different qualities of sand gave different results, and there should be tests of the mortar as well as the cement.—*The Canadian Engineer.*

PLAN OF A NEW SEA-WALL.

The Lincoln Park, Chicago, sea-wall on the lake front has been giving way from time to time, the large concrete blocks of which it is composed rest on piles, the constant action of the waves undermines the foundations, causing the blocks to fall into the lake. George Richardson, an inventor, presented a plan to the park board for a new sea-wall of concrete made by driving piles, to which wire netting will be attached, and the squares fitted with concrete. He says that with a sloping top such a wall would resist the action of the waves. The plan was referred to a new committee on north shore protection, composed of Commissioners Hirsch and Channon.

The Detroit Portland Cement Co., of Fenton, increased its capital stock from $5,000 to $1,000,000.

P. H. Carney has leased the Mankato Cement Works at Mankato, Minn., for three years with the privilege of purchase during the term of the lease.

The P. M. Bruner Granitoid Co., 308 N. 8th St., St. Louis, Mo., has issued a beautiful booklet, bound in boards, describing and illustrating the various specialties in Portland cement concrete and mortar manufactured by the company, as well as specimens of street and sidewalk work constructed by the company, stable floors, fireproof concrete floors, light concrete floors, with metal ceilings, Bruner's systems of hollow tile and concrete floors suspended ceiling with and without arch over same, Bruner's illuminated tile sidewalk construction, Roman mosaic floors and mantel facing, all executed in the highest style of art for this class of work. Parties interested in strictly first-class cement work will do well to send for the Bruner pamphlets, they are full of original ideas.

Bartlett & Kling of Galesburg, Ill., have secured the contract for the erection of the Galesburg public library, at $49,000 to $50,000.

G. L. Clausen, C. E., 164 La Salle street, Chicago, Ill., is preparing plans for an extensive sewerage system for the town of Lake Linden (Lake Superior region), Mich.

The firm of Isaac Usher & Son, cement manufacturers, Queenston, Ont., has been dissolved. Mr. Isaac Usher will carry on the business. Mr. Hudson Usher will engage in farming.

The Jeffrey Manufacturing Co. of Columbus O., has issued circular No. 61, describing and illustrating elevating and conveying machinery for mills, factories, mines, industrial and power plants, also the Jeffrey complete coal mine equipments, electric or air power. The circular is for general distribution. To be had on application.

It is reported that C. W. Mix has negotiated the sale of the T. Millen Co.'s cement plant at Wayland, N. Y. $25,000 earnest money has been put up by Connecticut capitalists. The works have been appraised at $450,000. The plant includes 200 acres of land and large buildings for the manufacture of cement. It is understood that the purchasers will make extensive improvements.

City Engineer Patton of Duluth, Minn., has been experimenting with cement sidewalks on steep grades. The cement walks with the ordinary finish do not give secure footing. Engineer Patton finds that with a rough finished surface the cement walk does not become slippery. Heretofore citizens have protested against the use of cement walks on the grounds above stated. All walks on steep grades in Duluth are receiving the rough finish and are satisfactory to pedestrians.

The Virginia Portland Cement Co. have issued a valuable pamphlet entitled, "How to Use Portland Cement," by Wm. G. Hartranft, with extracts from Das Kleine Cement Buch, the method of preparing concrete in frosty weather, tables of proportion for various kinds of concrete and cement mortar, notes on testing, and numerous tests with Old Dominion Portland cement for various purposes, as well as the construction of artificial stone for walks and floors, and other useful data, with numerous illustrations, all of which will be appreciated by the actual consumers of cement. The pamphlet contains 48 pages and will be sent gratis to any address on application to the Wm. G. Hartranft Cement Co., Real Estate Trust Bldg., Philadelphia, Pa.

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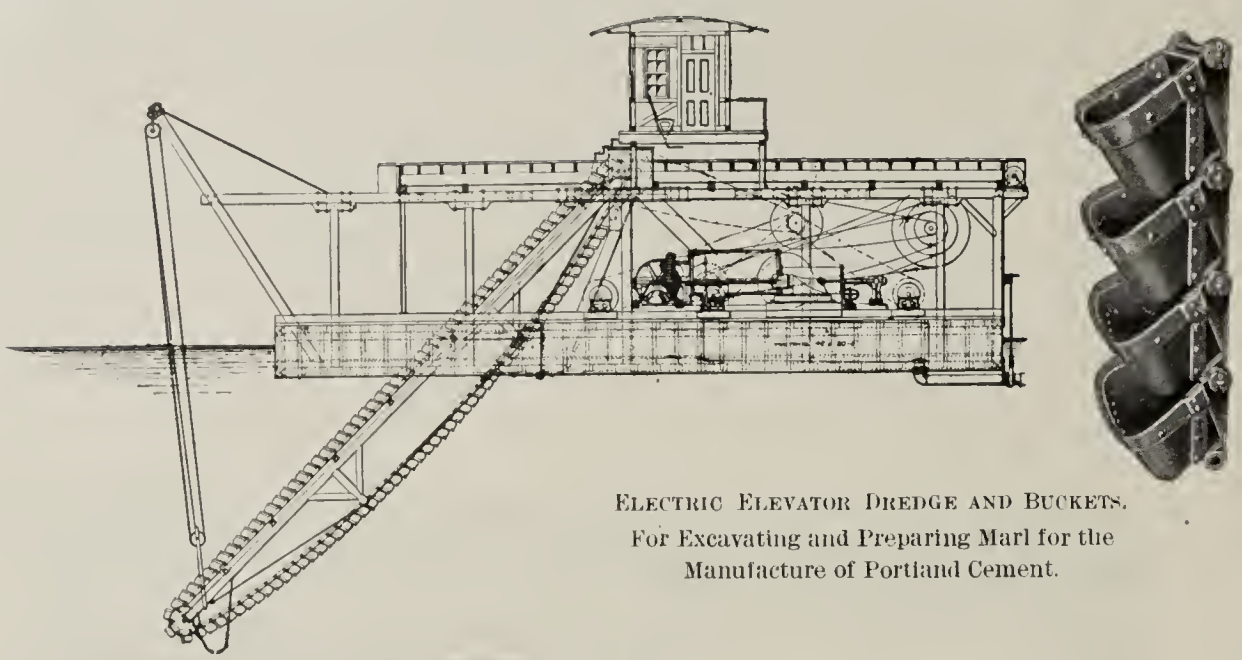

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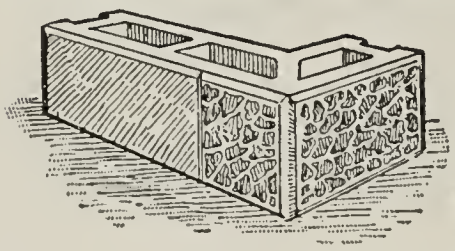

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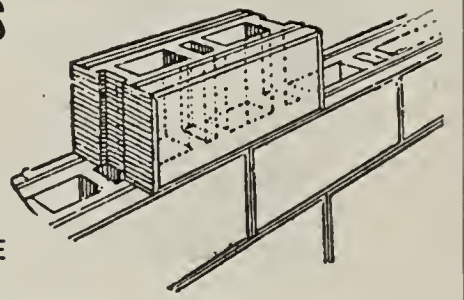

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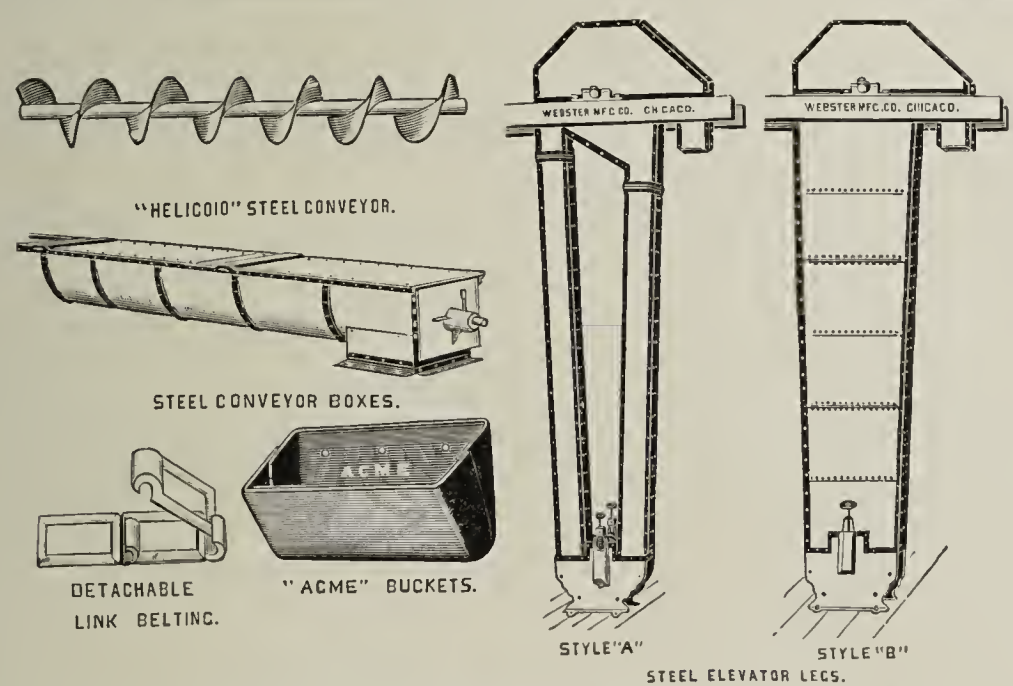

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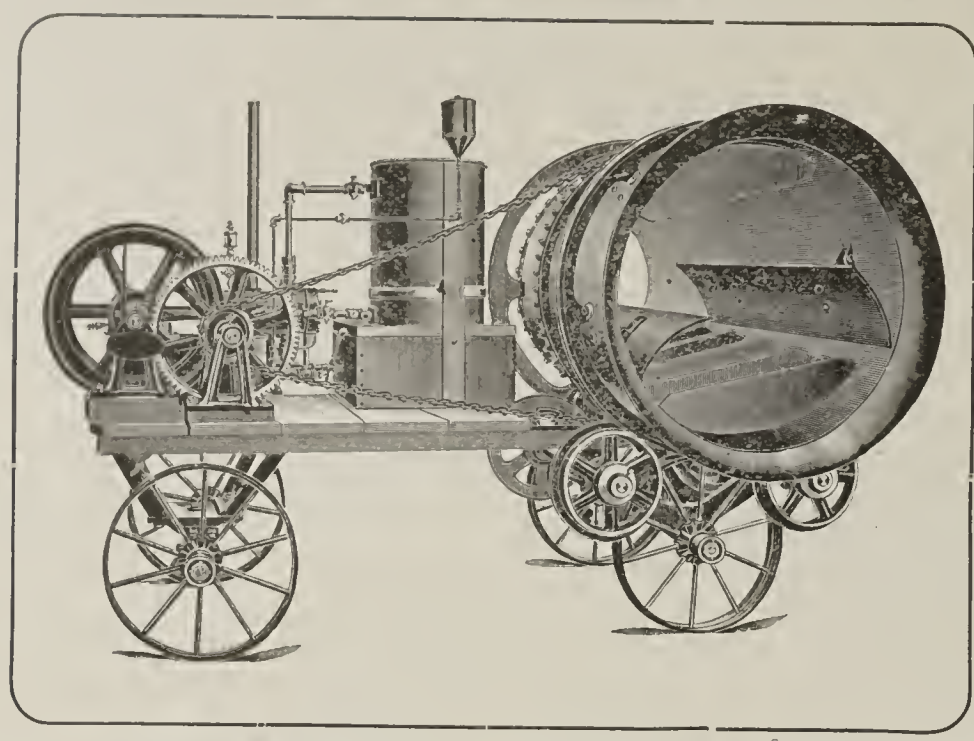

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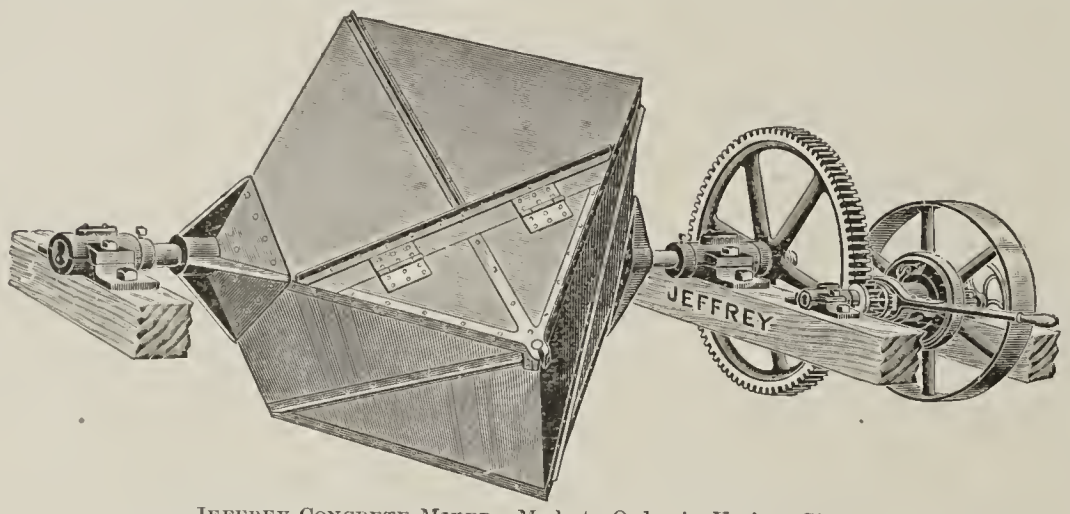

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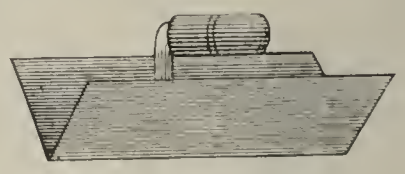

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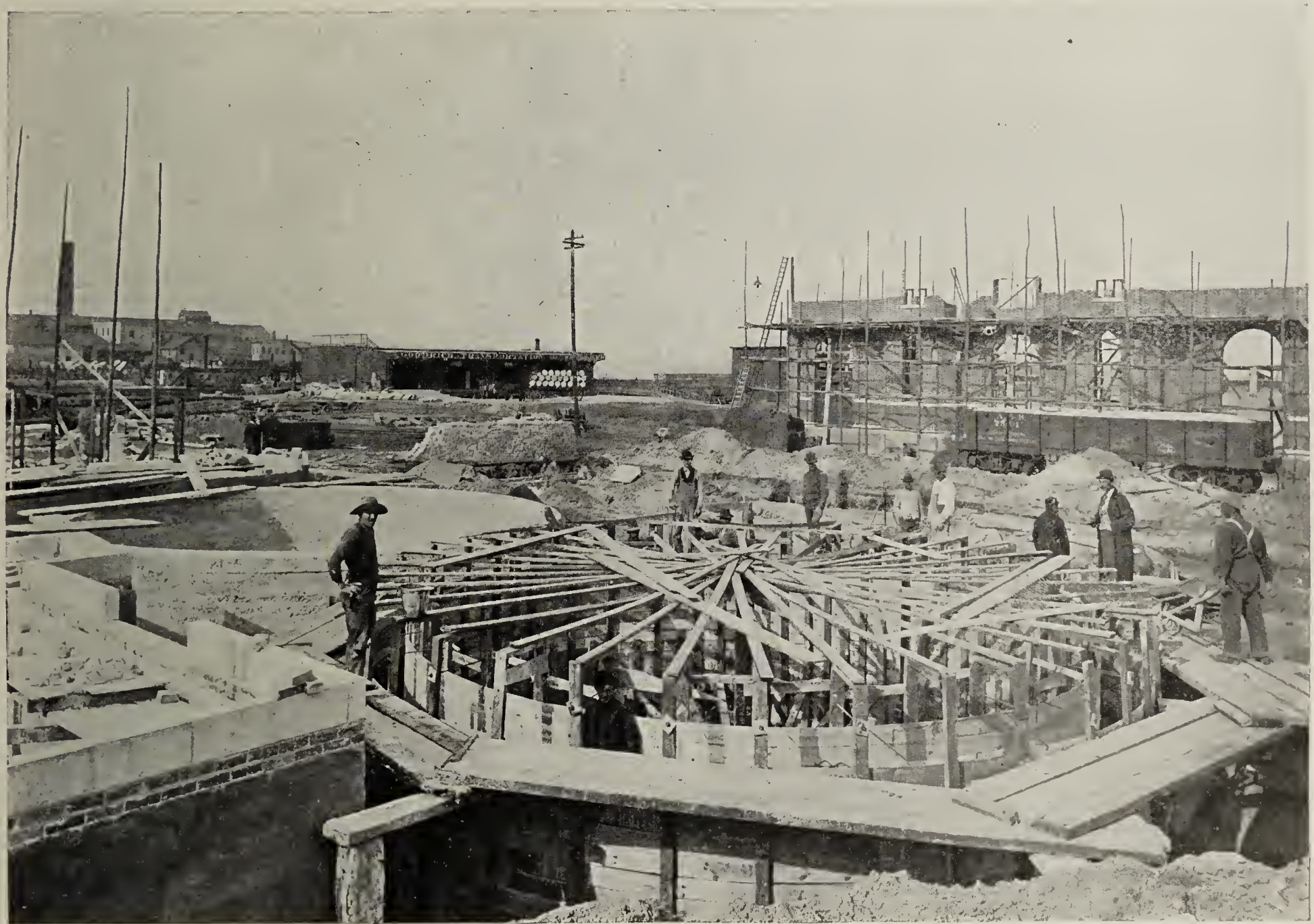

AMMONIA TANKS AT GAS WORKS, RACINE, WIS.—CONCRETE AND EXPANDED METAL CONSTRUCTION.

At the local gas works of Racine, Wis., there has been built recently two quite extensive tanks or wells of concrete, reinforced with expanded metal. These tanks are for the storage of tar and ammonia extracted from the coal in the process of manufacture of gas. They are each 25 feet in diameter and 9 feet deep. The exterior walls are 17 inches thick at the top, tapering to somewhat larger dimensions at the bottom. The footings of these walls were 12 inches in thickness, which footing rested on gravel foundations. The tanks are each covered with a concrete slab containing expanded metal and resting upon "I" beams bearing upon the outer walls. The expanded metal in the walls was placed close to the outer side of same. The resistance calculated was 500 lbs. per square foot. The concrete used was one part cement, two parts sand and five parts of broken stone. The tanks have been in use for several months and have answered every requirement without damage or harm.

CEMENT AND ENGINEERING NEWS.

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

A NEW METHOD OF DEPOSITING CONCRETE.

Heretofore specifications for concrete work have usually contained a clause restricting the casting of concrete from a shovel or otherwise not to exceed three feet fall, in order to prevent the separation of the crushed stone from the mortar, under the belief that good work could not be produced where a greater fall was permitted. In order to conform with this particular clause buckets were used for depositing the concrete in place.

In constructing the concrete pier foundations for the new Chicago Tribune building and the new Marshall Field building, the concrete is deposited directly from the shovel with a fall into the bottom of the shaft of fully 80 feet. The concrete so deposited is entirely satisfactory. The method pursued is very simple. The workman thrusts his shovel into the mixed concrete, swings the load over the opening and with a sudden jerk withdraws the shovel from under the load when it is permitted to fall into the shaft. The mass falls to the bottom of the shaft without separating or scattering in the least. A dull muffled report issues from the shaft after each shovel of concrete has been cast, showing that it has preserved its cohesion throughout its descent.

This method is found more economical and rapid than where buckets are used to lower the concrete, and should be adopted by contractors who desire to keep up with the times.

CEMENT IN CANADA, LATIN AMERICA AND WEST INDIES.

On the request of S. B. Newberry and THE CEMENT AND ENGINEERING NEWS, the state department caused the United States consuls to compile statistics relating to the cement trade in the various countries above named. This report is now before us and will appear in the regular June issue of the United States Consular Reports. The report should be in the hands of the American Portland cement manufacturers who desire to look into the export trade, as it gives the names and addresses of the principal importers, with wholesale and retail prices, and available shipping facilities. The United States Consular Reports can be obtained by writing to the Bureau of Foreign Commerce, State Department, Washington, D. C.; ask for the June issue. The report states that Portland cement in Guatemala sells for $12 per barrel retail and $10 wholesale, and $11.42 gold in Costa Rica, while freight charges from Limon to St. Jose, 102 miles, on 400 lbs. of cement $3.50 are gold. In San Salvador prices range from $9.86 to $10.29 per barrel; at Nassau, Bahama Islands, cement sells for 8 cents per quart or $4.80 per barrel. This is sufficient to demonstrate that the South American trade in Portland cement possesses peculiar features and before attempting to engage in South American trade, the situation will require careful study. Belgian leads in the South American cement trade, with Germany next in order, England comes next, while the United States cements are just beginning to obtain a foothold.

On another page we give the report of Consul Battiste from Port au Prince to show the class of information given by the various consuls on the subject.

Coldwater, Mich., has commenced the erection of Portland cement concrete dwelling houses.

The National Cement Company, Wampum, Pa., has been reorganized and changed from a limited partnership to an incorporated company. The new company is incorporated under the name of the Crescent Portland Cement Company, with a capital stock of $100,000. The headquarters are in Pittsburg, but there is a probability that later the offices may be moved either to Wampum, where the works are located, or to Beaver, as much of the stock is owned by residents of the latter town. The mills are being enlarged and remodeled so that the output will be at least 300 barrels a day. The alterations are to be completed by the first of July. At the last meeting of the stockholders the following officers were elected: W. O. Kirkland, Bridgewater, president; C. M. Hughes, Beaver, secretary; W. J. Prentice, Pittsburg, vice-president; George W. Hackett, Pittsburg, treasurer.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	APRIL.				TEN MONTHS ENDING APRIL.			
	1900.		1901.		1900.		1901	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	26,057,000	103,084	153,600	567	88,710,294	350,596	59,759,432	231,997
Belgium..	32,279,908	67,161	9,338,492	29,272	240,385,666	689,327	195,100,687	608,951
France	1,488,052	6,074	148,800	638	5,885,397	22,669	11,326,958	40,492
Germany.....	36,691,748	183.249	20,769,930	70,707	392,222,500	1,455,991	277,921,038	991,841
All Other Europe ...	4,541,628	12,798	396,800	1,302	23,349,240	74,297	21,725,019	63,746
British North Am...	75,800	106	596,550	2,684	973,590	5,217	1,855,010	9,306
Other Countries.....	662,000	2,921	....	.....	4,103,160	19,373	5,418,585	22,410
TOTAL	101,796,136	375,393	31,404,172	105,170	755,629,847	2,617,470	573,106,729	1,968,743
Domestic Exports of Cements, bbls.	7,893	19,103	28,392	48,061	62,145	133,193	146,838	301,433

There were 11,245,564 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on April 30, 1900, valued at $41,330, against 7,935,037 lbs., valued at $27,034 in April, 1901.

Imports of asphaltum or bitumen for April, 1900, were 7,661 tons valued at $29,701; April, 1901—8,993 tons valued at $38,311. For nine months ending April, 1900, 87,348 tons valued at $279,272; for nine months ending April, 1901—107,025 tons valued at $382,946.

HYDRAULIC CEMENT TESTS.

Mr. Nelson P. Lewis, chief engineer of the highways of the borough of Brooklyn, N. Y., in an interview, gave the following, concerning methods employed in his department, in applying such tests:

"Samples of the material to be used are sent to our laboratory and there undergo such tests as are deemed sufficient to expose the good and bad qualities. When received, the samples are first passed through a 20-mesh sieve to remove all foreign matter in the nature of sticks and straws. A small portion is then placed on a piece of paper, or preferably on thin oil-cloth, and for three or four minutes thoroughly mixed by alternately raising the corners of the cloth, causing the cement to roll over on itself.

"A chemical test is made to determine its composition and the relative amounts of lime, alumina, silica, sesquioxide of iron, magnesia and sulphuric acid or its equivalent of sulphate of lime.

"The first physical test is that for 'fineness.' The finer the cement, (if otherwise good) the more sand it will take, and, consequently, the greater its value. Three batches of 100 grammes each are weighed out, and for three or four minutes one batch is shaken through a 50-mesh sieve, one through a 100-mesh, and the third through a 200-mesh. The weight of cement that has passed through each sieve is ascertained and this, compared with the former weight, shows the percentage of fineness for each sieve.

"The time required for the cement to set is next obtained. A small quantity of neat (*i. e.*, pure) cement is mixed to a stiff paste with water and moulded into a pat. The time is noted until the pat will bear, without indentation, a wire one-twelfth inch in diameter, weighted with one-quarter pound. This condition is known as the 'initial' set. A further time is taken until the cement sets 'hard,' *i. e.*, when a wire one twenty-fourth inch in diameter with a weight of one pound will not indent the pat.

"Practically the only test that can be applied to ascertain the adhesive power of cement is that known as the test for tensile strength, after the material is subjected to various conditions of heat and moisture. For this work it is necessary to have a special machine, those of Fairbanks or Riehle being the ones usually employed.

"Small quantities of cement are carefully weighed out, each to be submitted to different conditions before being placed in the machine. The batches are mixed with water until a stiff, plastic paste is formed. The mixing, while thorough, must be done quickly to prevent the paste from setting. To obtain the right constituency, Rosendale cement requires about 25 per cent of water, Portland but 20 per cent or less. The paste is in the proper condition if, when rolled into a ball one inch in diameter and dropped onto a glass plate from a height of four feet, it still retains its general shape.

"When properly mixed, the paste is pressed, bit by bit, into forms of briquettes, each having an area of one square inch at the smallest cross section or 'neck.' Care is taken to exclude all air holes so as to secure a uniformity of structure, and the weight of each is carefully determined.

"Four briquettes are placed in water after setting hard and are kept therein for twenty-four hours before being tested in the machine. Four are kept in moist air for twenty-four hours and then, for six days, in fresh water at a temperature of 60 to 70 deg. F. The remaining briquettes are subjected to moist air for one day and then kept for twenty-seven days before testing.

"Another dozen briquettes are made from a mixture of two parts by weight of sand and one part neat cement if a natural or Rosendale cement is being tested, and of three to one if Portland. The sand employed is usually the standard quartz sand, composed of pure quartz crushed to a uniform fineness. In case of a test for any special purpose, the sand to be used on the work is employed, as the test becomes of more practical value thereby, but with the aim of contrasting cements the standard sand is necessary. The sand and cement are mixed dry and all the water added at once.

"Sets of four of these sand-cement briquettes are subjected to the same conditions as those of cement only. When ready, a briquette is placed between the clips of the machine, as shown in the illustration, and the stress applied at a uniform rate of about 400 pounds per minute. Very fine shot is allowed to run from a reservoir in the upper part of the machine into a pail. The weight of the pail and the shot is so multiplied by levers that a stress of about 1,000 pounds per square inch can be secured. The flow of shot continues until the briquette breaks at the neck between the clips, when the shot is automatically stopped. The pail and shot are carefully weighed by hanging them on the opposite side of the machine, and the amount of pull necessary to fracture the briquette is read off on the scale beam. As the arm supporting the pail has considerable motion, and that of the clips very little, the leverage is greatly multiplied.

"The Portland cement used in constructing curbs in Brooklyn must develop or exceed the following tensible strength per square inch. The time of experiment varies slightly from that already given:

"Neat cement after remaining 1 hour in the air and 23 in water, 225 lbs.

"Neat cement, one day in air, 6 days in water, 500 lbs.

"Neat cement, 1 part by weight, standard sand, 3 parts, one day in air, 6 days in water, 225 lbs.

"There is another important physical test necessary to be applied to cement, and that is the test for 'soundness.' It includes observations as to the cracks, distortions, color, etc., of the material when subjected to different conditions of temperature and moisture. Four quantities of neat cement are worked up into a stiff plastic paste with the proper percentage of water. These are moulded into pats, three inches in diameter, and about one-eighth of an inch thick at the centre, thinning out towards the edges. One pat is placed in moist air as soon as formed. Another is kept in a steam bath for three hours and then in boiling water for twenty-four hours. A third is allowed to set hard in moist air, when it is transferred to a steam bath for three hours, followed by boiling water for twenty-four hours. A fourth is placed in moist air until hard set, and then in water until tested.

"While passing through these conditions, the pats are critically examined. Any cracks, checks or distortions in the cement would cause its rejection as unfitted for use. The color must be alike throughout all the pats to prove uniformity of material. Should the pats work up hot, the presence of unslacked lime is indicated, and mortar, made of such cement would crack after being laid."

The village of Northville, Mich., is promoting the use of cement walks by purchasing cement in carload lots and disposing of it at cost to the consumer besides bearing a portion of the cost of laying the walk. Walks under this system cost the owner 5¾ cents per square foot.

The Onondaga Litholite Company of Syracuse, N. Y., has been incorporated with a capital stock of $30,000. The directors are C. A. Lockard, E. Bravender and Edward A. Kingsbury, all of whom are connected with the Empire Portland Cement Works at Warner, this county. The company will manufacture litholite and artificial Portland stone under the C. W. Stevens patents Harvey, Ill.

A NEW ERA IN INTERIOR LIGHTING.

By Charles L. Norton.

The age of plane glass has passed, to be succeeded by an age of scientific diffusion of light. Except where it is necessary to have windows through which to look, conditions of economy will soon forbid the general use of plane glass.

If our windows be of plane glass, the best and brightest light in the room is on the floor near the window, and it is here largely absorbed and lost. If, however, we interpose in the beam of light as it passes through the window a suitable diffusing medium, we may divert the light from its original downward direction into others where it will be more effective. The ribbed, corrugated, ground, and figured glasses now coming into common use are diffusing media for accomplishing this end, and it is to them and to their uses that it is the purpose of this paper to call attention.

In the year 1883, Mr. Edward Atkinson reported the method of constructing English cotton factories to his associates, calling attention to the use of rough-plate or hammered glass for glazing factory windows, it being claimed that a better light was distributed within, a claim which appeared to him to have a sound basis. Reasoning upon the subject, he first proposed to make prismatic glass with a view to deflecting and diffusing the light, but finding such glass very costly, and subject to other objections, he turned his attention to the types of glass already in use, causing photographic images to be made of the diffused light. These images showed that the common ribbed glass, in use for obstructing vision, also diffused light in a most effective way. He published the facts, and soon after many mills and works were either newly glazed or reglazed with ribbed glass. A discussion having arisen on the relative merits of ribbed and prismatic glass, it became necessary to bring the matter to a scientific basis.

In 1894 he brought the matter to me, and we have just completed a series of experiments begun at that time, to determine what gain would arise from the use of the new window glass in a large way in the windows of mills, schoolhouses and public buildings.

The extent of our knowledge on the matter in 1894 was certainly not large, and very few of my acquaintances of scientific bent believed in the practicability of any such scheme for improving the conditions of lighting. I was so sure that the insertion of a sheet of ribbed or corrugated glass in a window would be attended by a loss of illumination, that I designed my photometer to measure negative instead of positive quantities, and had the pleasure of rebuilding it.

The materials available for use as diffusing media in windows are of two distinct types: First, the corrugated and figured sheet glass; and

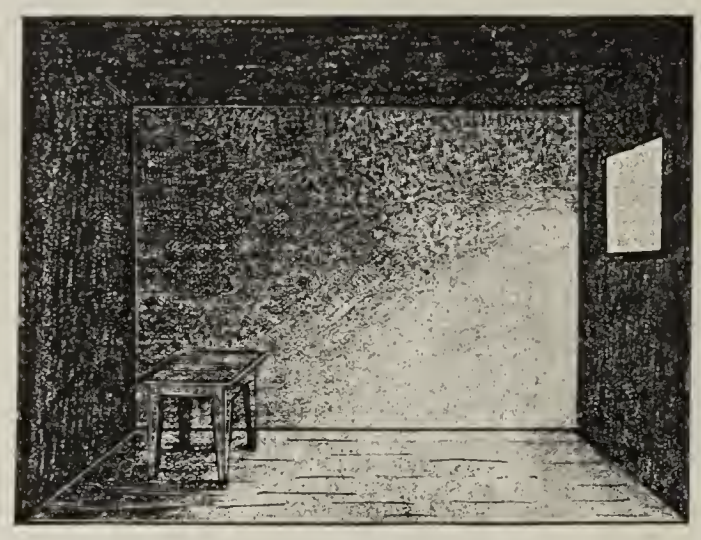

Fig. 1—Sketch Showing the Distribution of Light in a Small Room with a Window of Plane Glass.

second, the carefully designed and moulded prisms. Figures 1, 2, and 3 indicate the distribution of light in a small room with the window glazed in the different ways. After considerable study we came to the conclusion that the only data that would be of value to us in forming conclusions as to the practical utility of the diffusing glasses must be obtained from the examination of a large room lighted by a single window, in which the several glasses might be placed in rapid succession. The outdoor surroundings, the amount of exposed sky, the angular height of obstructions and the depth of the reveal over the window may be altered by means of suitable curtains. The method of

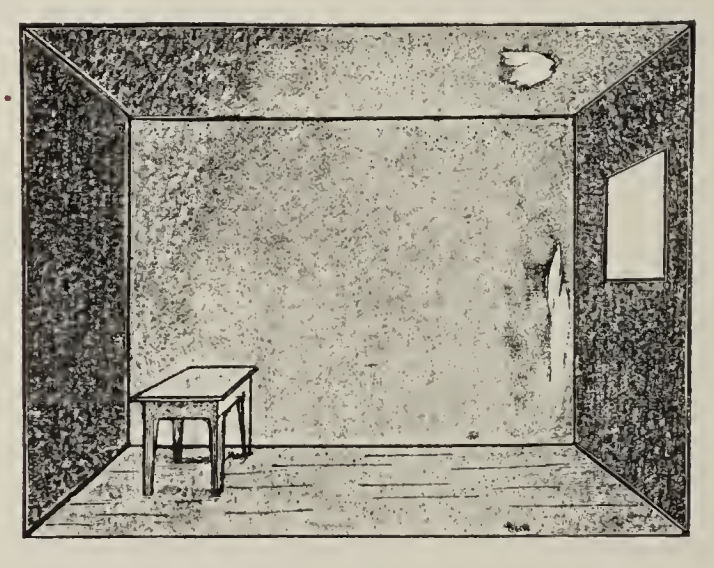

Fig. 2—Same as Fig. 1, with Factory Ribbed Glass.

procedure followed in the recent tests for the Factory Mutual fire insurance companies, under the supervision of Mr. Edward Atkinson, was as follows:

All the makers of diffusing glasses of whom we could find trace were requested to send samples if they desired to participate in the test. Nearly a score of samples were received in response to our circular letter, and a few samples were purchased.

The physics lecture room in the Walker building of the Massachusetts Institute of Technology, was placed at our disposal by the institute, and it proved to be in every way a suitable place in which to make the tests. All openings by which light might enter the room were closed, except one window on the west side. This window was 12 ins. square, and about 8 feet from the floor. The specimens of glass were inserted in the window in rapid succession, and photometric comparisons of the intensity of the light in the different cases were made. With each specimen the intensity of light was measured in a horizontal plane at the height of the table tops, observations being taken at stations 10 feet apart over the entire floor. The room was 50 feet wide and 40 feet deep.

The general conclusions to be drawn from the observations are: First, that in rooms of from 15 to 30 feet in depth, the ribbed or corrugated glasses will give an increase in the effective light at the level of the table tops, of from 200 to 500 per cent. Some of the prisms will do as well, but they are usually found to give too little diffusion in small rooms especially where the windows are few and small.

Second, in rooms from 50 to 100 feet deep, the ribbed or corrugated glasses will often give an increase of effective light of fifteen times the original amount, and the prisms, especially when set in canopies, will increase the light in some cases to fifty times its original effective strength. The determining factors in the case are the depth of the room, the angle of exposed sky, and the number and size of the windows. Stated broadly, the use of suitable prism canopies should make a basement as well lighted as a second story above it, glazed with plane glass.

The varieties of glass available for this work of diffusion are constantly increasing in number, and decreasing in cost. Among the less expensive are the ribbed or corrugated glasses. These may be had in different degrees of fineness of corrugation, in several thicknesses, and with the corrugations upon one or both sides. The finely corrugated glass with twenty-one ribs to the inch, has been known for several years as factory ribbed

glass, the name having been suggested by Mr. Atkinson. It is more sharply rolled than the glass with larger corrugations, and gives a better projection into deep rooms, but it accumulates dirt more rapidly than the coarser glasses. There are almost numberless figured glasses, with a design of some sort worked in low relief on one side of the sheet. These act as excellent diffusing media in small rooms, but do not pitch the light up toward the horizontal enough to be effective in deep rooms.

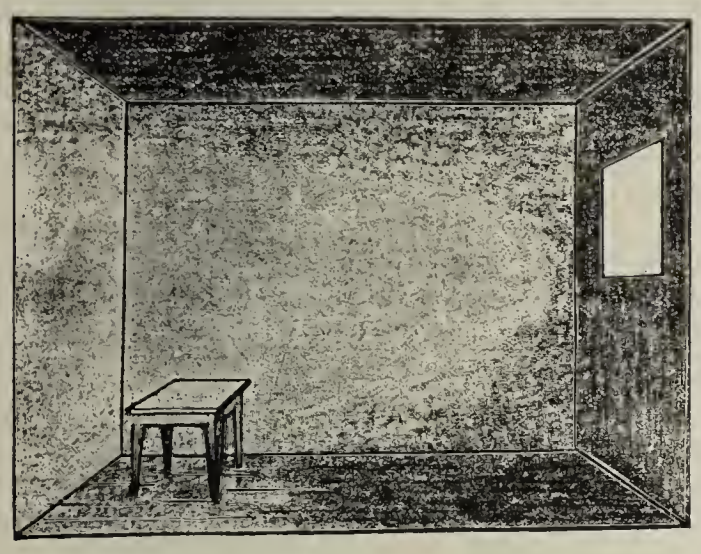

Fig. 3—Sketch Showing the Distribution of Light in a Small Room, with a Window of Prismatic Glass.

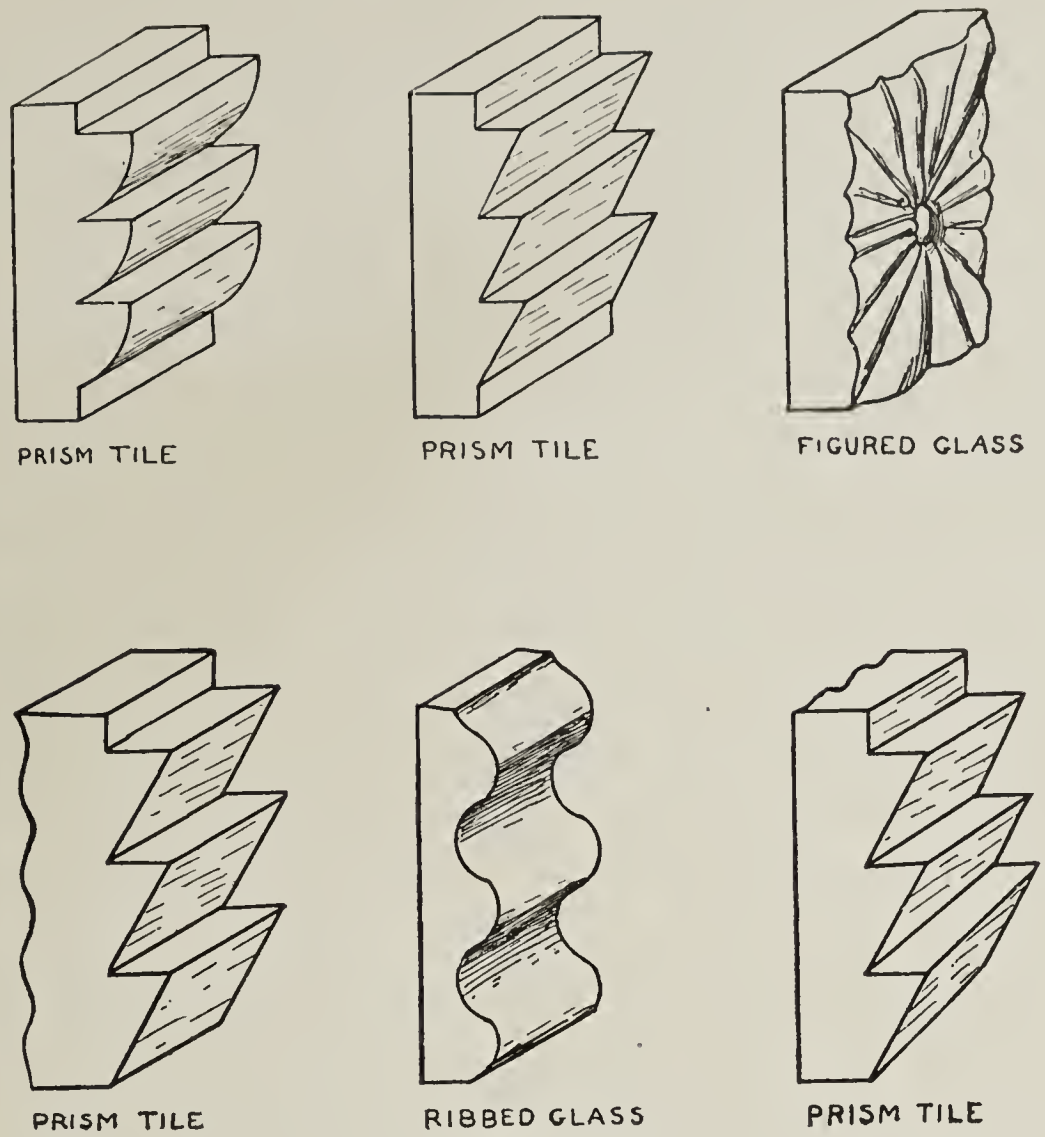

Fig. 4—Some Diffusing Glasses.

The prisms made by three of the large companies were tested, though one sample came to hand too late to be given a complete series of tests. One make of prisms consists of sharp, carefully moulded triangular prisms, usually in tiles or plates of about 4 inches square, and about $\frac{3}{8}$ of an inch thick. These are made of many different angles, and are installed only after careful consideration of the conditions under which the prisms are to be used. They are very satisfactory devices for projecting light in any desired direction in a room, with absolute certainty and with very little diffusion. A second prism differs from the first merely in that the lower surface of the prisms is curved instead of plane, giving a cross section which is substantially that of the lower half of the rib of the factory ribbed glass. This gives a wider diffusion, but less concentration of the beam where it is desired to throw it in one direction, as is often the case in deep rooms. The third make of prisms is quite similar to the first type, except that the outer side, or back of the prism plate, is not plane but slightly sinuous in outline. Enlarged sections of the different diffusing glasses are shown in Fig. 4.

The intensity measurements were made with a modified Cornu photometer, which served to compare the brilliancy of a piece of white porcelain placed at the window with that of a second piece which could be moved to any desired point in the room. This method gave measurements which were expressed in percentages of the intensity of the light at the window, and were wholly independent of the strength of the light at the window at the moment of comparison. A radial arm, 15 feet long, centered just below the window, was also used to carry the white screen, but it was found that the results obtained with an arm of this length were of little value in furnishing data on the action of the different diffusing glasses in rooms of a depth greater than 15 feet. The reason for the apparent discrepancy between the observed value of the intensity at the back of the room 50 feet deep, and the values computed from the measurements made at a distance of 15 feet from the window, lies in the fact that a very considerable and variable amount of light is reflected from the ceiling. It should be borne in mind that the light from the upper sash usually strikes the ceiling at a small angle, and that the reflecting power of even a dingy and rough ceiling is considerable at small angles. The glass which throws the strongest beam directly toward the back of the room may not furnish as satisfactory an illumination there as one which throws a more feeble beam directly toward the back wall, but adds a considerable amount to it by reflection from the walls and ceiling. It was therefore deemed better to measure the intensity of the light at a sufficient number of stations, and make an intensity map of the room for each kind of glass.

The examination of the different samples of glass showed at once that their usefulness lay largely in different fields, as was suggested above. In shallow rooms now fairly well lighted, the figured glasses give a soft, well-diffused light with an absence of glare and a material strengthening of the light in the rear portion of the room. As we study rooms 30 feet or so in depth, we find the figured glass gives too little light near the back of the room. Evidently something is here needed to throw the light further up toward the horizontal, as well as to give a nearly hemispherical diffusion, and the factory ribbed glass has here proved its value. The action of this glass is very interesting to me. It exists, not because of its diffusing properties, but because it is an obstruction to vision without many of the faults of the ground and painted glasses which were much used earlier. It was never designed to be a thorn in the flesh of the makers of prismatic glass, yet such, I fear, it has been for some time past. The fact that a cheap rolled glass can be of merit as a diffusing medium seems to be beyond the belief of the makers of the carefully moulded prisms. The relative efficiency of the rib and the prism is largely dependent upon the size of the sky angle to which they are exposed, and the depth of the room which they are to light. If the light

came from one point in the sky, and was to be used at only one point in the room, the angular prism of precise form would unquestionably be of the greatest value, and it is in the cases where those conditions are most nearly true that the prism finds its greatest field of usefulness. But in cases where the light comes from a broad expanse of sky, and is desired in wide diffusion throughout a large room, it is not easy to define the action of the different types of rib and prism. Stated broadly, the efficiency of the rib falls off more rapidly than that of the prism as the sky angle decreases, and as the depth of the room increases.

Let us now look at the changes which we may bring about in some particular cases by the use of diffusing glass, instead of plane glass. Take first the ordinary Boston type of school room, 28x32 feet, with windows on two adjacent sides. We have two conditions to consider, the presence or absence of the sun at the window, causing a great difference in the amount and distribution of the light. Without the sun, we find ordinarily that the half of the room nearest the windows is fairly well lighted. The exception is the occasional city school, with its tall neighbors in close proximity to its too few windows. It is desirable when the sun is not shining upon the windows to strengthen the light in the rear half of the room. On the other hand, when the sun is shining through the windows, the half of the room farthest from the windows is fairly well lighted, and the chief source of complaint is the too great brightness near the windows. Resort is usually had to window shades of greater or less opaqueness to cut off the light as a whole, for the benefit of the pupils within a few feet of the windows. The result is that the back of the room is insufficiently lighted at all times.

Suppose, however, we should put a suitable ribbed or prismatic glass in the windows. It is hardly practical to so adjust the glass as to give to those near to and far from the windows exactly the same strength of light, but the ratio of intensities may readily be changed from 20 to 1, to 2 to 1.

Consider the case of a large mill room with large window areas. We are here much less concerned with the amount of the diffusion from any one window, since the number of windows is so great as to give a satisfactory diffusion in those parts of the room which are within 20 feet of the windows. The ribbed glass and prisms act in such a room as deflecting devices, to carry the excess of light near the windows bodily back into the middle of the room. I have in mind a mill with two wings of a similar exposure. One is glazed with plane glass, the other with diffusing glasses, and on any cloudy afternoon you may find the plane glass wing all gaslight, while the other is amply lighted with diffused daylight. It is hardly necessary to add that as I write, the further substitution of diffusing glasses is being carried out in this mill.

In the large city stores we have still another condition of affairs, for here we meet usually with a deep, narrow room, lighted only from one end, with a window the full width of the store. We may usually count on finding the lower half of the window obstructed by merchandise. The city store rarely has more than a limited sky angle. The one thing eminently suited to improve the light here is the prism, especially if it can be set in canopies over the sidewalk. The thousands of square feet of prisms which have been installed within the last four years in the stores of our large cities attest the real commercial value of this device for this work.

In offices and in small rooms we have still another set of conditions to meet. Except where the sky angle is very small, we need here essentially a diffusion of as wide an angle as possible, with a much less regard for the upward tipping of the beam. We find here that the glasses worked with a raised pattern are of especial value. Some of them are of pleasing appearance, and are known as "Florentine," "Maze," "Arabesque," and "Figured" glass. There are many others by several makers, but these are typical of the whole class.

Skylights have long been a source of trouble when the sun strikes full upon them, but the substitution of a diffusing glass scatters all about the room, and puts to good use the light which otherwise fell so strongly upon some one spot as to make imperative the use of some sort of an opaque shade.

It is to be regretted, but it is certainly true that strong objection is often made to the "shut in" feeling which some people experience in rooms glazed wholly with diffusing glass. Repeated legislative action has been urged to prohibit the use of this glass in factories, and as a result it is now customary to confine the use of diffusing glasses to the upper sash. A more serious objection comes from the unpleasant and often unbearable glare of the glass when in the bright sunlight. The prisms are especially bad in this respect, but a remedy may be found even with them, in the use of a thin white cloth shade, to be drawn only when the sun strikes the window. We thus have the light at its maximum in dull weather, and can yet temper its brightness when it is necessary to save the eyes of those working in direct line with the light.

The substitution of ribbed or figured sheet glass for plane gives rise to no new mechanical problems, but the setting of the prisms in small tiles has called for a great expenditure of time and money. It is not quite certain that the present methods of holding the small tiles in metal frames by means of a cement filling or by an electrolytic deposit of copper are wholly satisfactory. The one is not easy to make tight while the other is so close a fit that the greatest care in relieving the frame from all strain is necessary, or the tiles become cracked or broken. The chief reason for making the prisms in small tiles has been heretofore the difficulty of rolling large sheets of prisms without deforming. The use of glass in large sheets for canopies over the sidewalks is prohibited by considerations of the safety of those passing underneath, so small tiles in stout metal frames must continue to be used for this work.

The action of prisms when set in canopies over a window is two-fold: first, as in the ordinary setting, to give an upward tip to the light; and second, to actually send through the window more light than would otherwise enter through it. Especially in narrow streets where the angle at which the light strikes the vertical is small, a canopy projecting into the street, even if of no greater area than the window will have incident upon it much more light. Being composed of total reflecting prisms, a canopy throws into a room almost all the light which falls upon it. Unlike the vertical prisms which are active by virtue of their refractive power, these total-reflection prisms have uppermost the surface through which the light enters, and they are more seriously affected by accumulations of dust and dirt.

The diffusion of direct radiant heat from the sun or from the sky follows much the same lines as in the case of light, but so large a proportion of the heat which enters a room comes in ways other than by direct radiation, but the main effect of the diffusing glasses is to prevent the local overheating of those portions of a room which are exposed to direct sunlight.

The criticism which has been offered several times, that the use of glass which prevents the direct entrance of beams of sunlight was injurious to the health of those living in rooms so glazed, is of course sheer nonsense. The action which light has upon disease germs can be operative as well through a diffusing glass as through plane glass.

In conclusion, we may safely predict a field of usefulness for the diffusing window, in improving the light in many rooms now dimly lighted, in making profitable the construction of rooms of greater depth, and in allowing of the closer approach to one another of tall buildings, with a resulting economy in land. – *Technology Quarterly.*

CEMENT TRADE IN HAITI.

(From United States Consular Report.)

Deputy Consul Battiste sends the following from Port au Prince, December 17, 1900:

The importation of Portland cement into this island has fallen off considerably during the past few years, on account of the severe financial distress which has been weighing on the country. While some years back from 4,000 to 5,000 barrels were received annually at this port, the importation is now only between 1,500 and 2,000 barrels.

The price paid here is $10 (Haitian currency) per barrel.

The principal importers in this city are: Green Knabel & Co., E. F. Mevs, Barbancourt & Co., L. Mevs & Co., R. Stark, Georges Reigner.

Shipping facilities are good. There are three lines of steamers, one plying weekly and the other two fortnightly between New York and the different ports of this island. The freight charged on cement is 80 cents per barrel. The customs dues are 25 cents per barrel, with 50 per cent, 33⅓ per cent and 25 per cent surtax.

The cement imported here comes from England, France and Germany, but principally from the latter country, via New York.

I am informed that recently an importation of United States cement was made here, and that while the quality gave no cause for complaint, fault was found in the packing. The barrels were not tight enough, and the staves were too light and not sufficiently hooped to stand the rough handling to which they were subjected in the transfer from the steamer to the lighters and from the latter to the shore. As a result, much loss was incurred.

Another drawback to the importation of United States cement is the term of credit; the German merchants grant six months, while the Americans only allow sixty days.

The marks imported are the Stettin Bredower "Eagle" brand, costing $1.65 to $1.70 per barrel in New York; the "Keystone" and "Blue Anchor," costing $1.65.

Attention is being turned of late to the construction of stone buildings, and naturally cement is largely used.

Cement and Engineering News $2 per annum.

LABORATORY OF THE ASSOCIATION OF GERMAN PORTLAND CEMENT MANUFACTURERS.

The Association of German Portland Cement Manufacturers includes representatives of eighty-six factories, the total annual output of which exceeds twenty million barrels. The annual meetings are held in Berlin, and many of the papers presented and the discussions which follow are of intense interest to students of cement technology. Committees of the association are actively engaged in the study of the action of magnesia in Portland cement, apparatus and methods for testing, the action of sea-water, and many other important practical and scientific subjects. In 1899 it was decided to build a commodious chemical and physical laboratory, and to employ an expert chemist and assistants in the scientific study of various questions relating to the cement industry. A piece of land, 200 feet square, was purchased at Carlshorst, a suburb of Berlin, plans for a laboratory were drawn and approved, and the erection of the building commenced. The laboratory is now nearing completion, and will be fully equipped before the annual meeting next February. The above photograph shows the laboratory as it at present appears.

The building is about 50x60 feet in size, and includes two stories and a basement. On the lower floor is a large room for preparation of test-pieces for tensile and compression tests, to be equipped with hammer apparatus and other machinery; a room for preservation of test-pieces in air and water, and a room for test-kiln and furnace work. On the second floor are the chemical laboratory, balance room and library, cement testing room, physical laboratory, and directors office. The building is constructed throughout of Portland cement, and furnishes a handsome example of the possibilities of this material in architecture. The cost of ground and building will exceed $20,000.

The chemist of the association, Dr. Max Wegner, is already engaged in researches on the chemistry of cement. The laboratory, when completed, will contain all the best and latest appliances for investigation, and will serve as a model for cement testing laboratories throughout the world. Manufacturers of Portland cement have reason to be grateful to the German association for the public-spirited manner in which the results of the investigations of its members and committees are placed at the service of the whole world.

The photograph from which our cut is made was taken by Mr. Andrew Newberry, who has spent the past year in Berlin with his grandfather, Ambassador White.

EUROPEAN CEMENT EXPORTS.

Value of cement exports declared from European ports to the United States, October 1 to December 31, 1900:

BELGIUM.	
Antwerp	$ 16,574.84
Brussels	45,063.63
Charleroi	5,193.24
Ghent	14,844.49
	$ 71,676.40
GERMANY.	
Bremen	$ 10,260.11
Brunswick	6,981.78
Cuxhaven	27,009.35
Essen	464.78
Frankfort	22,441.57
Hanover	40,426.17
Magdeburg	677.18
Stettin	8,518.79
Svensmunde	1,785.71
	$112,607.44
ENGLAND.	
Hull	$ 284.74
Liverpool	116.79
London	13,092.61
Newcastle-on-Tyne	9,927.66
Nottingham (Keins)	1,741.46
	$ 25,163.26

EFFECT OF DIFFERENT METHODS OF MOLDING UPON THE STRENGTH OF CEMENT.

By Ira O. Baker, Prof. of Civil Engineering.

It is well known that there is a considerable variation in the tensile strength of any particular cement mortar as obtained by different observers. Part of this variation is inevitable. The strength of hydraulic cement depends so largely upon the details of the method of testing that undetected variations in manipulation will make an appreciable difference in the results. Therefore it is important to eliminate as far as possible any variation in the method of testing the cement.

The amount of water used in mixing the test specimen materially affects the strength obtained; but recently it has become the practice in reporting results of experiments to state the per cent of water used, which practically eliminates this source of error. Of course different cements require different amounts of water according to the variation in composition, fineness, freshness, etc.; but a statement of the amount of water employed shows the condition under which the particular cement was tested.

The quality of the sand employed has a very marked influence upon the strength, but for some time it has been the custom of careful experimenters to employ only standard sand, either German natural sand or artificially crushed quartz having a standard degree of fineness.

The amount of force employed in pressing the mortar into the molds also has a very marked influence. Ordinarily the mortar is pressed in by hands and it is impossible to describe the intensity of the force employed. To eliminate this source of error, it has long been the practice in Continental Europe, particularly in Germany, to use an automatic machine in compacting the mortar in the briquette mold. In this country another machine for the same purpose has been lately put upon the market. The writer has recently made a series of experiments to compare these three methods of filling the molds. The results are stated in Table I.

All the tests were made by Mr. O. L. Gearhart, a former student of the author, who spent practically all of his time during the three past working seasons testing cement. He is a careful, methodical, observing, conscientious experimenter. In several cases results obtained by him by hand molding in the ordinary course of business have been compared with those obtained by other operators, and apparently his results are fairly representative of the usual methods of hand molding.

The Bohme hammer is the standard German machine, and consists of an arrangement by which the mortar is compacted by 150 blows of a hammer weighing 2 kilogrammes (2.2 pounds) upon a plunger sliding in a guide placed upon the mold.

The Olsen press consists of a plunger, driven by a screw and a hand wheel, working in a guide below the mold. The power applied is measured by a finger revolving in front of a graduated dial. The briquettes were molded under a pressure of 4,000 pounds applied to the broad side of the American Society of Civil Engineers form of briquette. The pressure was applied gradually to permit the air to escape, and was maintained at the maximum pressure, say, half a minute after the air ceased to escape. The escape of air is indicated by a gradual decrease of the pressure. The immediate purpose of the tests was to standardize this press. A pressure of 4,000 pounds was adopted as being a convenient number (equal to one revolution of the finger on the dial) and as being about as much as the machine would safely bear.

The cement was one that had been in the laboratory some months, and was supposed to be a representative Portland. The sand needs no description farther than stated in the table. The per cent of water employed for neat cement was that adopted by the operator as giving the plasticity usually employed by him, and is about an average of the quantity ordinarily used by him with other cements. The resulting mortar is not at all jelly-like, and water, or rather moisture, flushes to the surface only after vigorous troweling. The per cent of water for the mixture of sand and cement was chosen as giving apparently the same plasticity for the mixture as for the neat mortar.

Lines 4, 5 and 6 of the table are given to aid in studying the relative effects of the different methods of molding. The mean of the per cents in lines 4 and 6 for all ages, is shown in Table II.

Table I.

Effect of Different Methods of Molding on the Tensile Strength of Cement Mortar.

Ref. No.	Method of Molding	Neat Mortar with 16⅔ % of Water			1 Part Cement to 3 Parts Standard German Sand with 6½ % of Water			1 Part Cement to 3 Parts Standard Crushed Quartz with 6½ % of Water.		
		1 day	7 days	30 days	1 day	7 days	30 days	1 day	7 days	30 days
		Pounds per Square Inch								
1	Hand	258	342	470	74	104	225	63	92	213
2	Bohme Hammer	388	514	575	84	162	194	86	168	324
3	Olsen Press	232	312	563	33	68	90	50	92	132
		Relative Strengths in per cents								
4	Hand	67	67	82	89	64	116	73	55	66
5	Böhme Hammer	100	100	100	100	100	100	100	100	100
6	Olsen Press	61	61	98	39	42	47	58	55	42

Table II.

Strength of Hand-Molded and Press-Molded Briquettes in per cents of the Strength of Hammer-Molded Briquettes.

Method	Neat	Sand	Quartz	All
Hand	73	90	65	76
Press	73	43	25	73

From Table II it appears that hand-molded and also press-molded briquettes are only about three-fourths as strong as hammer-molded briquettes. Table II also shows that for this operator hand-molding was substantially the same as press-molding with a pressure of 4,000 pounds. Three months after making the above tests, the same operator with another cement made a series of briquettes in which the strength of the hand-molded specimens were 78 per cent as strong as those molded with the Bohme hammer apparatus. Apparently then this operator's personal equation with reference to the Bohme apparatus is 77 per cent, or in round numbers, three-fourths; and with reference to the Olsen press is 76÷73= 104 per cent, or in round numbers unity.

The hammer apparatus gives the greater strength, but it requires a longer time to mold a briquette than by hand or with the press. About 35 minutes are required to mold 6 briquettes with the Bohme hammer, 20 minutes with the Olsen press, and 15 minutes by hand. The hand-made specimens were finished with the trowel on both sides; those from the press and the hammer were finished with the trowel only on the top. With a quick-setting cement there is danger with the hammer apparatus and also with the press, of encroaching upon the time of the initial set, before completing the last briquette of a set. The amount of skill required is practically the same in all three methods. There was not much, if any, difference in the uniformity of the results. This particular cement was rather quick-setting, and

hence part of the variation with the hammer apparatus may have been due to an encroachment upon the time of initial set. However, in a later series with a slow-setting cement, the three methods of molding gave about equal variations.

If others should make similar experiments with either or both machines, it might result in greater uniformity in hand molding, and also give data of value in comparing results obtained by different observers.

EDISON PORTLAND CEMENT COMPANY.

The Edison Portland Cement Company expects to commence making cement about November 1. $1,000,000 has so far been spent on the company's land and plant at New Village, N. J., $125,000 representing the cost of the land, which includes about 700 acres of lime-stone and cement-rock.

It is expected that about $400,000 more will be required to put the plant in running operation and provide working capital up to about April 1, 1902. This additional $400,000 will probably be raised by the issuance of treasury preferred stock with which will be given as bonus an equal amount of common stock.

The company's management expected to be in operation this spring, but serious delay has been occasioned by the non-delivery of certain structural material by the Phœnix Iron Company.

The production at the outset will be about 1,500 barrels a day, which will be increased as quickly as practicable, and by April 1, 1902, will, it is expected, be at the rate of 4,500 barrels daily. The full capacity of the plant will be 10,000 barrels a day, but with improvements now in process of manufacture, it is expected that 20,000 tons a day can be produced, which amount is about one-seventh of the country's entire consumption of all kinds of cement. No attempt has yet been made to market the prospective output.

The cost of production will vary with the amount produced. It is estimated that on an output of 1,500 barrels per day, the cost will be about 80 cents per barrel, which will be reduced to 45 cents per barrel when the plant is turning out 4,500 barrels daily. The cost will be further reduced to about 28 cents per barrel when a capacity of 10,000 barrels is reached. Beyond this it is not thought wise to estimate, but even lower figures, such as 20 cents, are thought possible.

The company has a contract with Mr. Edison by which it has secured patent rights to all his inventions relating to the manufacture of Portland cement for the United States and Canada. It has also secured the personal services of Mr. Edison as general manager for the term of 10 years. Mr. Edison receives as part consideration a large block of the company's common stock, and as a further consideration, by the terms of the contract, he gets one-half of whatever sum per barrel, in the cost of production, he can save below the sum of 60 cents.

The officers of the company are: W. H. Shelmerdine, president; W. S. Mallory, vice-president; W. S. Pilling, treasurer; C. I. Crane, secretary; Thomas A. Edison, general manager. These gentlemen are also directors together with Luther S. Bent, Harlan Page, Henry L. Townsend and E. C. Miller.—*Philadelphia Bulletin.*

OVERHEAD SUSPENDED FERRY.

The accompanying illustration shows a suspended ferry erected at Rouen, France, for traffic across the river Seine. It consists of a suspension cable bridge, the two cables carry two lines of rail on which a truck frame mounted on small wheels rolls from one side of the river to the other, 160 feet above high water.

Iron rods run from the frame of the truck downward and connect with the carrier in which freight and passengers are carried across the channel. An electric motor mounted on the truck frame furnishes the motive power to propel the ferry from shore to shore. This ferry system is the invention of F. Arnodin and A. de Palacis of France.

The board of trustees of the Oregon State Reform school has received bids for about 4,500 square feet of concrete work. E. M. Sorber of Salem, was the lowest bidder at 11¾ cents per square foot, and he will be awarded a contract. The work is principally the laying of basement floors and the building of walks.

EDISON ON CONCRETE BUILDINGS.

Thomas A. Edison, the well-known electrician, in the course of a recent interview, among other things, said: "Cement, combined with steel, will be the building materials of the future. The forms will be made of wood and a contractor using one of the standard shapes will simply go out and 'pour' a house. Contractors will put up their concrete mixer and have their beams and forms ready. They will pour the form for the first story and so on. To do that all they will require will be common labor —a few men and one boss. That is what I think will eventually be done. Portland cement when it becomes cheap enough will be used; one part cement, three parts sand and five parts of broken stone or crushed gravel. High buildings will be of steel construction with Portland cement. The outside of buildings will be of cement instead of brick or terra cotta as now, and the inside structural steel work incased in cement. Portland cement is an alkali, and iron never rusts in the presence of an alkali."

PETITION REDUCTION OF RATES.

The Texas railway commission is considering a petition from Texas cement manufacturers for a reduction of the present maximum tariff of 23 cents for 200 mile haul to 18½ cents on cement. In the meantime an agreement between the railways and manufacturers has been reached whereby the maximum tariff is to be 18½ cents on short hauls and for a greater reduction on long hauls, and that the 11a tariff is to be amended to apply on lime so as to permit a car containing half cement and half lime to be shipped at the carload lime rate. At present there must be 75 per cent lime and 25 per cent cement. Under the language of the circular calling for the hearing, the commission held that an amendment to the lime tariff, as above proposed, could not be adopted without special notice of hearing, and in order to overcome this error they consented to give notice of a future hearing. In the meantime, letters will be addressed to the principal railroads, advising them of the result of the agreement and stating why the hearing was called, and requesting them to present their views on the subject to be considered.

Four concrete grain elevator tanks have been erected for the Hoosier State Flour Mills at Indianapolis, Ind. Each tank is 60 feet high and 26 feet in diameter, giving a combined storage capacity of 86,000 bushels. The concrete walls are 8 inches thick. Steel hoops are imbedded in each layer of concrete.

PRACTICAL ADVERTISING FOR THE EXPORT TRADE.

Hon. O. P. Austin, chief of the bureau of statistics, is advocating a floating exposition for the promotion of our export trade, the idea being to send a ship to the principal parts of the world with exhibits of various articles of American manufacture, and in this way bring to the notice of foreign merchants the actual goods, wares and merchandise we are offering for sale. Benjamin Franklin has wisely said "that people like to become acquainted before they begin to trade with each other. Mr. Austin's idea of a floating exposition is the best means of accomplishing the end in view, as it will in a great measure bridge over the diversity of languages spoken by the people of the earth. American goods, wares and merchandise will thus be made to speak for themselves by their simple presence in every language spoken by the people the ship may visit. From every point of view the scheme is eminently practical and has our fullest endorsement.

"The imports of Asia, Oceanica, Africa, and the American countries south of the United States amount to over $2,000,000,000 per year. Nearly all of these importations are of the very class of goods which we desire to sell—foodstuffs, textiles, mineral oils, machinery, and manufactures of all kinds; yet our sales to these grand divisions in the best year of our commerce, 1900, only amounted to about $200,000,000, or 10 per cent of their purchases. The annual imports of Asia and Oceanica are over $1,000,000,000, those of Africa over $400,000,000, and those of the countries lying south of the United States about $600,000,000.

"Most of the cities through which these $2,000,000,000 worth of goods are first distributed lie on the sea coast, and could be readily reached by a fleet of vessels loaded with samples of American products and manufactures. The lack of practical knowledge as to the local trade requirements, such as methods of packing, kinds of goods required, length of credit, etc., is the chief obstacle to the introduction of American goods in these countries, and that until this obstacle shall have been overcome we cannot expect to obtain the share in that trade to which our location and facilities of production and manufacture entitle us."

Such a floating exposition will not only educate merchants abroad but likewise the American exporters who, by actual contact with prospective customers, will become familiar with the exact requirements to be met in the extension of the trade sought.

We assume that the expense of the floating exposition is to be defrayed by the merchants having the exhibits an board. We likewise believe it to be within the province of the United States government to subsidize the exposition by liberal contributions of money, at least for the initial enterprise.

Our great trust corporations have shown how American trade can be promoted abroad in special lines of manufacture. Their success has already shaken up the trade centers of Europe. Why cannot a circuit of the globe be made equally successful in pursuing Mr. Austin's idea of an American floating exposition? We believe it can. Mr. Austin's project should be encouraged and sustained by the enterprising American manufacturers for whom he desires to open new channels of trade in the remotest corners of the earth.

GERMAN OPTICAL AND PLATE GLASS INDUSTRY.

One of the most important industries in my consular district is the manufacture of optical and plate glass and, associated therewith, the construction of scientific and optical instruments. There are two enterprises engaged in this industry, both of which export to the United States. The Deutsche Spiegelglas Actien Gesellschaft, the works of which are situated at Freden, in the province of Hanover, but at the same time in the Brunswick district, manufactures plate glass and lenses for eyeglasses.

The incorporated firm of Voigtlander & Sohn Actien Gesellschaft manufactures optical glass and scientific instruments. During the year ended December 31, 1900, the value of the optical and plate glass shipped to the United States from this district was $82,193 and the value of the scientific instruments $1,379. The factory of Voigtlander & Sohn is situated in the city of Brunswick and was established in 1756. It is said to be the oldest enterprise in this line of business. It employs two hundred and sixty hands and has a staff of fifteen foremen, who are scientifically and technically trained. One branch of the business is the manufacture of photographic objectives of all systems and sizes; euryscopes are made, as well as anastigmatic collinears and apochromat-collinears, used by photographers and employed for process work of all kinds.

This firm also manufactures all sorts of hand and tripod telescopes up to 6 inches (diameter of objective) and Galilean and prismatic binoculars. Since 1811, there has been continual progress in this sort of work, great improvements having been made in the technique of melting glass and the instruments having been lately brought to a high state of efficiency. The firm has recently introduced in the construction of its instruments a new alloy of aluminum and magnesium, called magnalium, which greatly reduces their weight and renders them weatherproof. The managers supply the German navy with marine telescopes and have furnished the German artillery with 6,000 glasses. The trade with the United States has become so important that they have established a branch factory in the city of New York. The firm has gained a reputation for a short rifle telescope which is in general use by sportsmen in Germany.—Talbot J. Albert, Consul, Brunswick, Germany.

SUGGESTIONS FOR USING PORTLAND CEMENT.

(From "Hand-Book of Useful Information For Cement Users," issued by the California Portland Cement Co.)

Keep the cement perfectly dry until ready to use it in mortar.

Use dry, clean, sharp sand, and use the least amount that will fill the voids. Increasing the percentage of sand reduces the strength and slows the setting. Wet up only so much mortar at one time as can be used before setting commences.

Do not permit the finished work to dry out quickly; after it has commenced to harden cover with wet sand or burlaps and keep wet for a fortnight. Concrete ditches, flumes and reservoirs should be washed over with a thin cement, grouting fast as built. After the mortar has set a day or two it is well to flood it and keep the water standing stagnant a fortnight.

If the finished work cannot be kept covered as above, keep wetting it by daily sprinkling. Water is the life of Portland cement mortar.

When concrete is laid in large bodies it is allowable to imbed irregularly throughout its mass as many large stones as is consistent with their being well bonded together by the mortar.

In concrete it is desirable that the aggregates should be graduated in size, then they pack closer and require less cement mortar to fill the voids. The stone should be hard, angular and free from dust.

Do not mix lime with cement, it tends to make the mortar crack.

In masonry the stone or brick should be thoroughly wet before laying.

In sidewalks, as fast as the concrete is tamped to a surface the top coat should be spread on in order to bond the two layers together.

Ordinary lampblack injures cement mortar, mineral colors do not; sienna, Prince's metallic, Venetian red, Prussian blue, ground coal

or oxide of manganese are good.

Before laying concrete the ground should be saturated with water and rammed to prevent absorption of moisture from the mortar or settling.

The longer a Portland cement is kept the slower setting it becomes, provided it is not kept in an air-tight package.

Portland cement factories can usually furnish either a slow or quick setting cement if allowed sufficient time to meet the requirement.

The better the ultimate quality of concrete the slower it is in hardening.

The aggregate used in making concrete, whether it be crushed stone or gravel should be clean, hard, angular and durable. If crushed stone be used it must be freed from the dust that adheres to it in passing from the crusher. This can be done by turning water on it. The stone should also be screened, not to secure a material of uniform size but to keep the sizes between maximum and minimum limits.

No parts smaller than coffee beans or larger than one and a half inches in any direction should be used. All dust should be screened or washed out.

The amount of mortar needed will depend upon the percentage of voids between the particles and should be sufficient to completely fill the spaces and bond the stones together.

Good gravel affords a cheap and durable material for concrete, the difficulties are that it is liable to be dirty, the pebbles are not angular and as used, it often contains an excess of sand.

Burlington, Iowa, laid 2¾ miles of cement sidewalks in 1900.

A Portland cement plant is being promoted at Deer Creek, Mich.

A new Portland cement plant will be erected six miles from Florence, Col.

Owensboro, Ky., has let contracts for 25,000 feet of combined curb and gutter.

The Michigan Portland Cement Co. shipped 43,000 barrels of cement in May.

The Wichita Gas Co. of Wichita, Kan., is erecting a power house of artificial stone.

Experiments are being made at Newayo, Mich., in the manufacture of cement brick.

The Peerless Portland Cement Company of Union City, Mich., will double the capacity of its work.

One cu. foot of dry cement shaken down weighs 100 lbs. and will make about 0.53 c. ft. stiff paste; 25% water.

A Portland cement plant is under promotion at Charleston, S. C.

An asphalt deposit has been discovered three miles from Texarkana.

The Diamond Portland Cement Co. is drilling for oil on the Henry Bixler farm, Middlebranch, O. One well already down yields gas.

Cement mortar is being used as a filler and binder on new brick pavements at Elgin, Ill. Hot tar has heretofore been used for this purpose.

The Great Northern Portland Cement Co. is pushing the construction of its plant with great vigor under the supervision of competent high grade engineering skill.

Cement Books: How to Use Portland Cement, 50c.; Monier Constructions, Steel and Cement, 50c.; Constitution of Hydraulic Cements, 25c. For sale at this office.

Incorporated: Ætna Cement Plaster Company of Kansas City, Mo., capital stock, $25,000. Incorporated by D. P. Thomas, S. Howard McCutcheon, E. D. Holliwell and R. M. Brackett.

Dixson & Lowry of Duluth, Minn., have secured the contract from the Board of Public Works for laying cement walks for the city of Duluth for the season of 1901, at 18 and 23 cents per square foot.

The American Cement Co. of Philadelphia has declared the usual semi-annual dividend of 3 per cent and an extra one per cent, payable July 15th to stock of record July 5th. Books close on the latter date.

The pier head block of concrete of the north pier of the Duluth ship canal, weighing 430 tons, was put in place on June 8th and 9th. A similar pier head block is already finished on the south pier of the ship canal.

Plans are being prepared by Philadelphia engineers for a large cement manufacturing plant to be erected by a local company near Allentown, Pa. The plant will consist of two buildings, which are expected to cost about $50,000.

A concrete highway bridge of two spans, 150 feet each, is to be erected over the South Platt river near Denver by the Board of Public Works of Arapahoe county, Colo. For information address, Julius Aichele, county clerk, Denver, Colo.

Incorporated: The United States Portland Cement Company. Principal office, 220 Liberty street, Plainfield, N. J.; object, manufacture cement; capital, $10,000. Incorporators: Ernest R. Ackerman, Marion S. Ackerman and Leslie M. Daniel.

J. F. Lackey of Charlotte, Tenn., is promoting a stock company for the development of asphaltum deposits.

Ex-Mayor A. S. Hewitt, William R. Grace & Co. and E. H. Norton & Co., bankers of New York, have organized the Ecuadorian Association, capital $2,500,000, to work the newly discovered asphalt deposits on the island of Salango, off the coast of Ecuador.

Incorporated: Pennsylvania Portland Cement Company. Principal office, No. 259 Washington street, Jersey City, N. J. Object, manufacture Portland cement; capital, $500,000. Incorporators: Foster E. Harvey, William L. Brockway, Michael J. McTiernan.

The Ohio cement works in the northwestern suburb of Lisbon, O., was destroyed by fire May 24, involving a loss of $10,000. It was well insured. The concern was a well equipped and prosperous industry, employing about 40 men. It will be rebuilt at once.

The Charles Munson Belting Company, 38 South Canal street, Chicago, is distributing an advertising novelty in the form of an aluminum horse shoe carrying an imbedded penny. A four-leafed clover is stamped on the face of the shoe bearing the motto: "keep me and never be broke."

A steel and concrete tunnel designed to be used to supply condensing water to the Thirty-ninth street power-house of the New York Edison Company was recently launched at the Crescent shipyards, at Elizabethport, N. J. The tunnel was designed by Haight & Lande, who are also the inventors and patentees. It is 225 feet long, 12½ feet in diameter and weighs 1,200 tons. It consists of exterior and interior shells of ¼-inch steel, between which is 15 inches of concrete. The tunnel will be towed to the East river, where it will rest on a foundation of piles and rip-rap 23 feet below the surface. The cost was $75,000.

The McKelvey Concrete Machinery Company, 1206 Security Building, Chicago, is meeting with unqualified success in the sale of its machinery, to large railway corporations, who are repeating their orders for this excellent concrete mixer after a full year's experience in its use, on all kinds of concrete work. The McKelvey Company now manufacture three sizes: small hand mixers with a capacity of fifty yards and upwards; medium power mixers with a capacity of 100 yards and upwards, and large power mixers with a capacity of from 200 to 400 yards daily. These mixers are now in use in various parts of the United States and Canada.

The Atlas Portland Cement Co. has purchased a lime rock deposit at Hannibal, Mo., suitable for the manufacture of Portland cement, upon which a large cement plant will be erected in the near future.

Fire was discovered in one of the large steel buildings of the Helderburg Cement Co., at Howes Cave, June 8th. Just how the fire originated is not known but it is thought to have been caused by an electric wire. The entire inside of the building, which was constructed of wood, was consumed.

A company has been organized, with $100,000 capital, to work the gypsum deposits on the Horace A. Wilder farm, just east of Akron, N. Y. R. H. Bell, I. D. Eckerson, Frank M. Stage, W. M. Cumming and W. E. Patch are the promoters of the enterprise. New York and Buffalo capitalists are interested.

Articles of incorporation were filed at Trenton, N. J., in the office of the Secretary of State for the Capital Portland Cement Company, with John W. Manning of Trenton; A. H. Bigelow, Stewartsville, and T. P. Marshall, Trenton, as incorporators. The capital stock is $3,000,000. Business will be commenced with $1,000.

We are in receipt of a beautiful lithograph sheet from the Charles R. Miller Paving Co. of Memphis, Tenn., entitled "The Heroes and Leaders of the Civil War," with portraits of the leading confederate and union officers, issued as a souvenir of the eleventh annual reunion of the united confederate veterans held at Memphis, Tenn., May 28 to 30, 1901.

All the $400,000 capital stock of the Marksboro Portland Cement Co. has been subscribed and contracts will be let in a few days for ten buildings. Offices have been opened at 66 Maiden Lane, New York. The works are at Marksboro, N. J. A Mr. Brooks of Boston is the head of the company but Andrew C. Snyder and Philip Scanlon of Newark and Henry V. Snyder of Paterson are interested.

Asphalt and oil has been discovered nine miles southwest of Nevada, Mo., on the farm of Henry Hogan. J. A. Jones, a mineral expert, says the deposit is worth $15 a ton as it comes from the ground. A bed 50 feet wide, 2,000 feet long and from 12 to 60 feet thick has already been located. Six companies, including one from Boston, with $6,000,000 capital, are taking leases. One or two drills are running and derricks for others are going up. Des Moines, Kansas City and Chicago capitalists are on the ground.

The Howard Cement Company of Cement, Ga., re-elected the following officers: President, J. H. Warner; vice-president, B. L. Goulding; secretary and treasurer, Porter Warner. The company has just completed a series of new steel kilns at their works which will largely increase the output. In addition to this they have made a number of new openings in the strata of cement rock, obtaining a better quality of stone.

During the year 1900 94 25 miles of concrete sidewalks were laid in Chicago against 5.85 miles of stone laid during the same period. The total mileage of walks laid in the city to date is $1,076.26 miles against a total of 285.96 miles of stone walk; 968 miles of concrete walks were laid under permits from the city: By the South Park Commissioners, 31.72 miles; by West Park Commissioners, 68.54 miles; Lincoln Park Commissioners, 7.11 miles. During the cold weather quite a number of stone sidewalks are laid in the business district when cement work is out of season.

A company which will be known as the Eureka Portland Cement Company has been organized and incorporated for the purpose of building a mammoth cement works near Suisun, Cal. The company is composed of prominent San Francisco men and is capitalized for $1,000,000, all of which has been subscribed. The directors of the company are L. Rosenfeld, H. Rosenfeld, W. H. Talbot, H. W. Goodall and A. T. Fletcher. During the past year the projectors of the enterprise have had an expert, R. P. Doolan, examining the lime deposits of this and adjoining counties, and finally it has been decided that the lime deposit on the farm of A. A. Dickie is most suitable for the plant.

The Pacific Portland Cement Co. will erect works four miles east of Suisun, Solano county, Cal. The company is capitalized at $500,000. George Stone is the president, Nathan L. Bell, secretary, and these with Joseph F. Kilby, Samuel McMurtrie and Morris Kind constitute the board of directors. There is only one Portland cement plant existing in California. At Colton four large buildings have been designed of steel and corrugated iron, no wood being employed. The kiln building will be 200 feet long and will contain seven rotaries. Each building will have one side removable, so that a duplicate plant can be set up beside the original. The buildings and machinery will cost about $250,000. Nathan L. Bell organized the company. All the money needed has been raised. A representative is in the East negotiating for the machinery.

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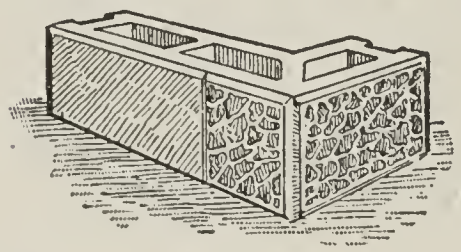

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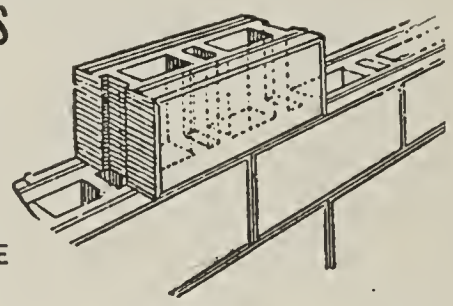

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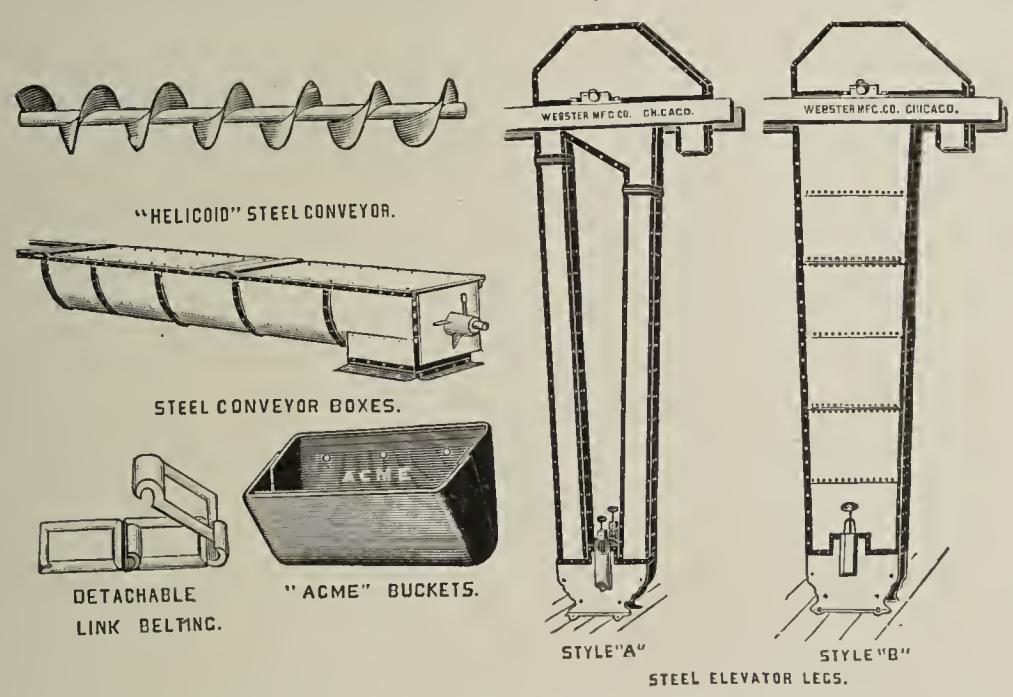

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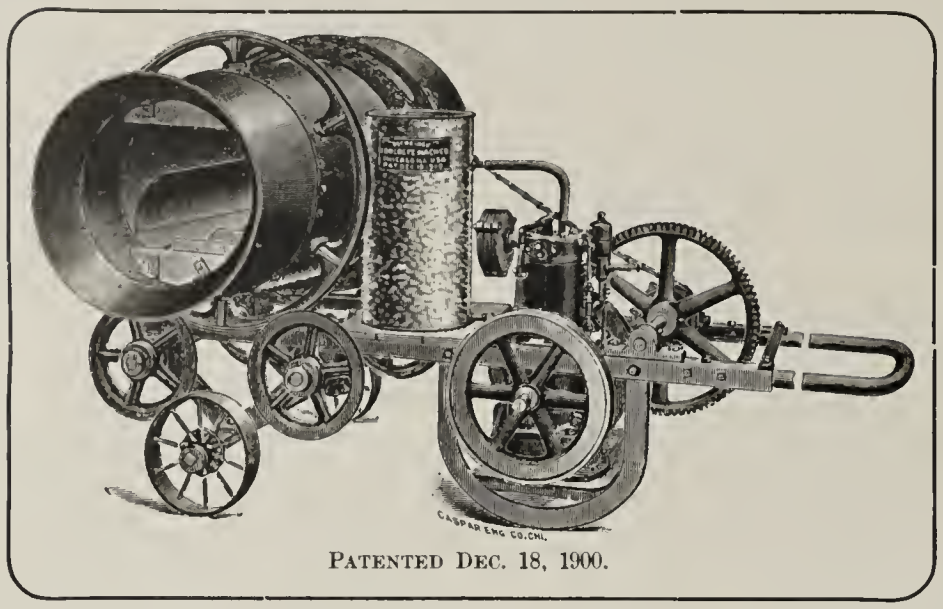
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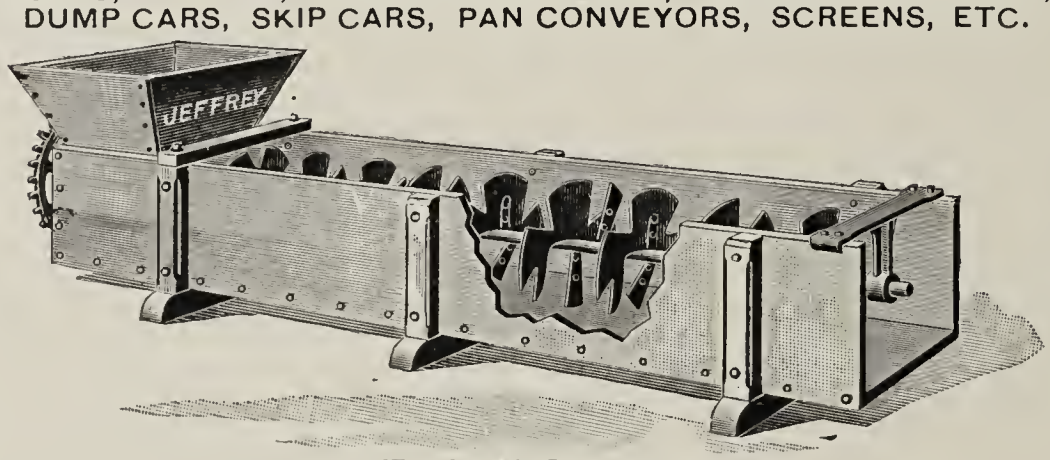

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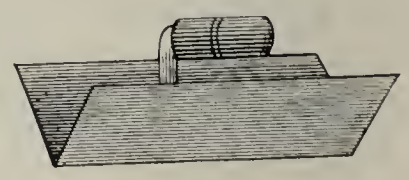

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CEMENT AND ENGINEERING NEWS.

Vol. XI, No. 1. CHICAGO, JULY, 1901. Price, 25 Cents.

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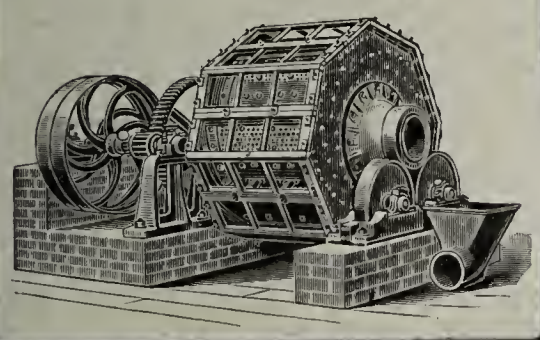

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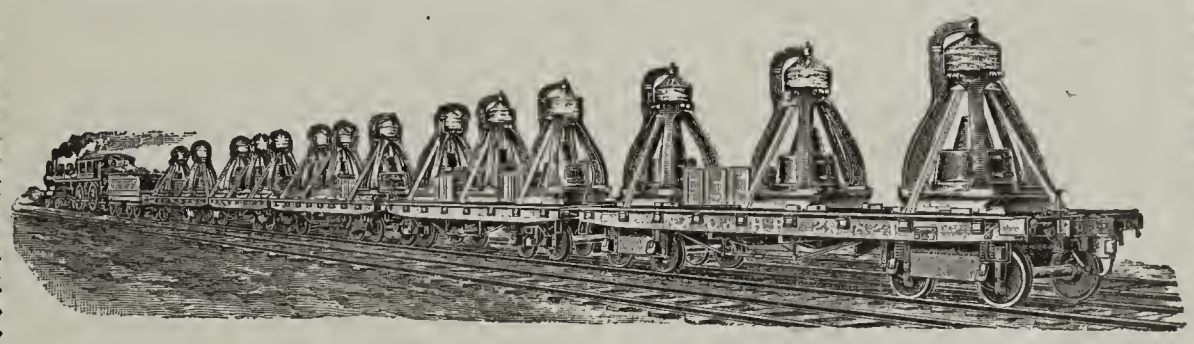

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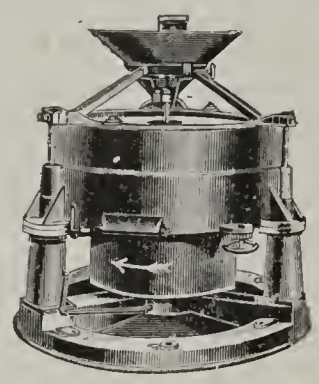

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CEMENT
.....AND.....
ENGINEERING NEWS

THE DOWN-STREAM SIDE OF THE BEAR-TRAP DAM, CHICAGO DRAINAGE CANAL AT LOCKPORT, ILL.

The Secretary of War has recently granted permission for a flow of 300,000 cubic feet of water per minute over this dam between the hours of 4 P. M. and 12 o'clock midnight. The illustration shows a flow of about 250,000 cubic feet per minute. Our May issue contained an illustration of the up-stream side of the same dam. The opening for the flow of water between the concrete masonry bulk heads is 160 feet in the clear, the flow being regulated and controlled by means of two great metal leaves and capable of oscillating 17 feet vertically in the 160 feet opening between the concrete bulk heads, one of which is shown in the present illustration.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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Chicago, July, 1901.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

CONCRETE VS. BRICK CONSTRUCTIONS.

Certain tax-payers in the city of Buffalo, N. Y. have brought suit against the Comptroller of the Board of Public Works to restrain the payment of money on a $449,000 contract awarded to the Buffalo Dredging Co. for constructing a sewer and retaining wall on the Hamburg canal, within the city, on account of a change in the specifications from brick to concrete and expanded metal for the arch of the sewer, whereby the brick interests lose the sale of $20,000 worth of brick, which is said to be the animus behind the suit, while the cause stated in the petition is "that concrete construction is new and untried and, therefore, undesirable, while brick construction is old and reliable."

This is the old cry of the brick interest, pure and simple. The same arguments were advanced against the use of concrete and steel by the Chicago brick interest for the arches of the Lawrence avenue junction chamber, intercepting sewerage system of Chicago. Concrete and steel construction was adopted for the work as the only satisfactory material available under the problem confronting the engineers. It is to be expected that the brick manufacturers throughout the United States will oppose the use of concrete on all public work where it has been customary in the past to use brick, under contracts let by municipal corporations. The brick manufacturers and bricklayers unions usually resort to what is termed "political pull" to oppose the use of concrete construction. When this resource fails they go into the courts and ask for injunctions, under which they hope to pick a flaw in some part of the contract. The bricklayers' union and brick manufacturers of Chicago have, by reason of a combination of large capital and thorough organization, exerted a political prestige which has successfully deprived the city of Chicago of miles of concrete sewers in the past.

The arguments advanced against concrete construction by the brick interests are usually shallow and entirely at variance with the facts. The brick interest look upon themselves as pensioners of the community in which they reside, vested with inalienable rights to construct perishable monuments in honor of their craft at public expense.

The general public is fast becoming educated to the use of concrete in public works. The sooner this education becomes diffused the sooner will just and proper bounds be prescribed to the activity of the brick maker and his political pull.

Cement and Engineering News $2 per annum.

EDISON PORTLAND CEMENT.

The completion of the Edison Portland Cement Company's initial plant near Philadelphia has been financed by an underwriting syndicate and stockholders taking a block of $500,000 preferred stock and some common stock which has been reserved in the treasury. There had been so reserved of the original issue $1,000,000 preferred and $300,000 common stock, and there is therefore at present a balance of $500,000 preferred stock in the treasury. Substantially all of the $9,000,000 common and $1,500,000 of the authorized $2,000,000 preferred is now issued and outstanding.

The original unit now to be put in operation as soon as it can be completed, which it is hoped will be early next year, will have a capacity of at least 1,500 barrels per day and eventually 4,500 barrels. The plant is so constructed that by an extension of 30% of the original a productive capacity of 10,000 barrels per day is claimed.

CEMENT IN PERU.

Consul Dickey writes from Callao, May 29, 1901: I submit below such information regarding Portland cement as I have been able to procure:

Imports during 1899 (latest obtainable)

Country.	Quantity.	
	Kilograms.	Pounds.
Germany	1,090,575	2,304,282
England	157,398	347,000
Chile	242	534
United States	23	51

Following are the names of the principal importers: W. R. Grace & Co., New York and Lima, Peru; H. M. Beausire & Co., Lima; C. Weiss & Co. Lima; C. M. Schroeder & Co., Lima.

Prices: Wholesale, $6.50 Peruvian silver ($2.85) per barrel of 180 kilograms (396.8 pounds); retail, $6.80 to $7 Peruvian silver ($2.98 to $3.06) per barrel of 180 kilograms (396.8 pounds.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	MAY.				ELEVEN MONTHS ENDING MAY.			
	1900.		1901.		1900.		1901.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom	3,196,610	12,242	362,704	1,567	91,906,900	362,838	60,122,136	233,564
Belgium	19,518,360	63,374	3,810,042	9,644	259,903,620	752,701	198,910,729	618,595
France	297,600	1,277	1,368,800	5,624	6,182,997	23,946	12,695,758	46,116
Germany	58,145,364	201,122	22,058,327	82,767	450,367,874	1,657,113	299,979,365	1,074,608
All Other Europe	1,988,522	6,451	456,801	1,297	25,338,062	80,748	22,181,820	65,043
British North Am.	280,300	1,638	228,650	1,164	1,253,890	6,855	2,083,660	10,470
Other Countries	480,000	2,034	700,806	3,005	4,583,160	21,407	6,119,391	25,415
TOTAL	83,906,756	288,138	28,986,130	105,068	839,536,503	2,905,608	602,092,859	2,073,811
Domestic Exports of Cements, bbls.	7,976	16,775	41,102	79,520	70,121	149,968	187,940	380,953

There were 7,712,742 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on May 31, 1900, valued at $26,584, against 6,943,765 lbs., valued at $27,946 in May, 1901.

Imports of asphaltum or bitumen for May, 1900, were 10,296 tons valued at $41,676; May, 1901—18,856 tons valued at $64,052. For eleven months ending May, 1900, 97,644 tons valued at $320,948; for eleven months ending May, 1901—127,881 tons valued at $447,016.

IMPROVEMENTS ON THE NILE.

Of the many ancient monuments that still exist on the banks of the Nile, none will be more enduring than the Assouan Dam. This great work will be a memorial of the British sojourn in Egypt, and in boldness of design and thoroughness of execution will rank with anything that has ever been constructed in this land of Titanic achievements. The following sketch will give a fair idea of the progress and present state of the work:

All the low-level sluices have been practically completed. These will let the water through even when the Nile is low, and will be shut or opened, according as water is required. There are altogether 180 sluices and 150 low-level sluices. The lowest level water ever reaches at Assouan is 85 meters (278.89 feet) above the Mediterranean. By means of the dam, the water will be held up to 106 meters (347.6 feet) above the same level. The very lowest sluices are 65 in number and they have been made recently. An idea of the immensity of the labor involved in their construction may be obtained from the fact that the foundation of the deep sluices goes 75 feet below the ordinary rock surface. Each sluice is fitted with steel gates, adjustable at will, so as to enable the water to go in and out. The foundation was the most difficult portion of the whole work; seven-eighths of it is now complete. One gap has been left to relieve the western channel, but all the foundations have been built in this gap. The most important work now in hand is the construction of the dam across the western channel, the last of the five deep channels of the river which cross the line of the dam and carry the supply of the Nile in winter and summer. Temporary dams for the work have already been constructed, and the excavations for the foundations are in progress. A temporary dam of earth has recently been made on the south of the west channel. Another temporary dam on the north will soon be made, and then the pumps will be set to work to get the intervening water out. All the foundation masonry will be in and should be above water before the beginning of the Nile flood this year. When this has been accomplished, the difficult part of constructing the great dam will be over. It is now expected that the foundations of the west channel will be completed by the middle of May, 1901.

Besides the vast labor immediately entailed by the dam, another great work directly connected therewith is being undertaken at the first cataract. As the dam will close the Nile to navigation, a canal of about 2,000 meters (6,540 feet) in length is being constructed. There will be four locks, each 9½ meters (10.3 yards) broad and 80 meters (87.2 yards) in length, the first gate to be about 20 meters (21.8 yards) behind the center of the dam and the others north of it. The recess for the first lock gate has just been started, and the work of construction is now actively in progress. The gates will be of steel. When shut, they will stand across the opening of the canal and when open they will slide into a recess prepared for their reception in the western wall. The foundations for the second and third locks are similarly in progress. The east wall of the first lock and the west wall of the second have already been built to the height of something more than 8 meters (8.7 yards). The foundation of the first lock floor is at 90 meters (98.1 yards) level, the others being respectively at 89, 86, and 83 meters (97, 93 7, and 90.4 yards) level. The canal will permit sailing vessels to pass all the year round; heretofore they could only get through the cataract during high Nile. The mail steamers and any stern-wheeler now on the Nile will also be enabled to pass. The cost of this canal will be approximately £250,000,* or $1,250,000, and would require £20,000 to £25,000, or from $100,000 to $125,000 in lock dues per annum, if it is ever to be a paying investment. But there is very little prospect of an immediate increase in trade; in fact, the reverse is probably the case. Formerly, there was a fair amount of carrying trade from the north, bringing supplies to the armies in the Sudan, and seed and grain has also been brought from the countries now depopulated and ruined by the Mahdi's and Khalifa's followers. This commerce is now gone, and the only carrying trade of any importance in the future will be from the south to the north, as the southern districts become more cultivated. The area, in any event, must necessarily be limited. Although a great volume of trade passes Shellal now, the construction of a railway from Assouan to No. VI station is only a matter of time, and the trade from the north of the dam will consequently be limited to the district between Assouan and Wady-Halfa, which will not be tapped by the railway. The construction of this canal is, in fact, due to what may be styled "moral considerations." The Egyptian government does not wish to bar the navigation of the oldest water way in the world and to cut off the villages between Shellal and the second cataract from all communication with the outer world; for when the canal is finished, the line to Shellal will no longer be used. It is proposed, when the dam is finished, to tranship goods by the canal to Halfa, at Assouan. At the present time, about 150 native boats start from Shellal to Wady-Halfa every week.

The two chief works that will be undertaken during the next five months are to get the west-channel foundation in and to complete to their finished levels those parts of the dam whose foundations are already laid. In 1902, the work will practically be confined to finishing up. The great enterprise has gone too far for even a high Nile to hinder the completion of the dam.

No precise details can be given as to the cost of the work. The original estimate of the construction of the two reservoirs at Assouan and Assiout was £2,000,000 ($9,886,000). The excess over this estimate will be great, although it can not be accurately gauged at present, owing to the greatly increased depths which had to be excavated before sufficiently sound granite on which to found the dam was reached. The whole work will be finished at least a year before the time specified in the contract, which was five years. This will save one low Nile, and this early completion of the dam will therefore be of great utility and benefit to Egypt. Such is the present status and condition of the work which will mark an epoch in Egyptian history.

A more curious jumble of the ancient and modern would be difficult to find than in this enterprise. The best mechanical appliances of the twentieth century are used amid the very quarries which furnished the materials for the colossal structures of Pharaonic age. The rocks that are being quarried to-day bear the grooves and notches made by laborers who died thirty centuries ago.

* The Egyptian pound, valued at $4.943 is used throughout this report.

The Michigan Portland Cement Co.'s plant at Quincy, Ill., has closed temporarily.

There is a general complaint against the poor quality of paving brick used on the streets of Chicago. Brick pavements two years old have continuous ruts four inches deep due to inferior material. The trouble with vitrified paving brick is due to the fact that they are not properly annealed, being withdrawn from the kilns too soon which render them brittle. The cooling process should be delayed from 10 to 20 days. This will render the brick tough and durable. Paving brick makers are too anxious to get their brick into the market, this should not be. All specifications for paving brick should designate annealed brick. Until this is done the complaint on account of poor brick will continue.

FUEL CONSUMPTION IN PORTLAND CEMENT BURNING.

By S. B. Newberry.

The cost of fuel is a considerable item in the expense of manufacture of Portland cement, and it is this feature of the process which offers best prospect of improvement in the matter of economy. The development of the rotary kiln, which effected an immense saving in labor and made the growth of the American Portland cement industry possible, was something of a step backward in economy of fuel. Now that high-grade Portland cement is made and sold in this country at far lower price than anywhere else in the world, it is becoming a vital matter with manufacturers to save expense at every possible point, and the problem before cement engineers is to reduce to a minimum the waste of fuel in the rotary kiln. With this in view, the writer has calculated the heat theoretically consumed in producing a barrel of cement under various conditions, and submits the following results in the hope that they may contain some suggestions which will be of use to those who are interested in this important question. In view of the great diversity of conditions at different factories a calculation of this kind can, at best, be only approximate, and it is hoped that other cement engineers will criticise the writer's estimates and conclusions, and contribute the results of their own study of the problem.

The amount of fuel used in burning a barrel of Portland cement, (380 lbs.) in the types of kiln generally used may be approximately stated as follows:

Intermittent vertical kiln (coke)	76 to 95 lbs.
Continuous vertical kiln	42 to 46 "
Rotary kiln, dry material	110 to 120 "
Rotary kiln, wet material (50% water)	150 to 160 "

These figures represent the best modern practice, and apply only to high-grade fuel. At many factories the coal consumption is considerably greater, owing to wasteful methods or use of inferior fuel.

It should be remembered, also, that the consumption is generally figured from the weight of coal *purchased;* this is usually considerably in excess of the amount of dry coal actually *burned,* owing to moisture in the fuel, shortage in weight, and loss of dust in grinding.

The difference in economy between continuous vertical and rotary kilns is not in reality so great as the above figures indicate, owing to the fact that the raw material for the former must be moistened, molded into blocks, and dried. The latter operation requires additional fuel, probably amounting to 20 or 25 lbs. coal per barrel.

The actual burning of cement consumes a definite amount of heat, which is absorbed in evaporating the water contained in the material, heating up the dry mixture, decomposing the carbonate and sulphate of lime present, heating the gaseous products to the stack temperature, and, finally, heating the calcined material to the point of sintering. As the specific heats and heats of decomposition of all these substances are known with considerable accuracy, it is possible to calculate, at least approximately, the number of heat units and amount of fuel which should, theoretically, be required to produce a barrel of cement under various conditions.

Let us first consider the fuel to be used, and the heat made available for cement burning by its combustion.

In burning coal a considerable part of the heat evolved is expended in raising the products of combustion to the stack temperature, while the balance remains available for useful work. It will simplify our calculation, therefore, if we determine the heat actually available from one pound of coal with the products of combustion escaping at 400°, 700° and 1,500°, respectively.

Let us assume the use of a Pittsburg coal of the following composition:

Moisture, 1.4; carbon, 75.0; hydrogen, 5.0; oxygen, 8.0; nitrogen, 1.0; sulphur, 1.6; ash, 8.0.

This coal will have a theoretical value of 13.400 heat units, and for its combustion will require 10.2 lbs. air per pound of coal. Assuming the air of the kiln room to be at 60 degrees F., we find that the products of combustion of one pound of coal, and the heat units required to raise them to the temperatures mentioned, will be:

	at 400°	at 700°	at 1,500°
2.75 lbs. carbon dioxide (sp. ht. .22)	206	386	871
.464 lbs. water " " .48	76	142	321
8.065 lbs. nitrogen " " .24	660	1,242	2,794
Total	942	1,770	3,986

If 50 per cent more air be used than that theoretically required, this will absorb at 400°, 424 h. u.; at 700°, 800 h. u.; and at 1,500°, 1,800 h. u. The available heat of 1 lb. of coal under these various conditions will therefore be:

Gases at	400°	700°	1,500°
	13.400	13.400	13.400
Products of combustion consume	942	1.770	3.986
Heat units available, with theoretical air	12.458	11.630	9.414
50 per cent excess air consumes	416	7.784	1.763
Heat units available with 1½ theoretical air	12.042	10.846	7.651

Let us now assume that the raw cement material, which we shall hereafter refer to as "mix," has the following composition:

Carbonate of lime, 75 0; silica, 15.0; alumina and iron oxide, 5.0; magnesia and alkalies, 2.0; combined water, 2.0; sulphuric anhydride, (SO_3), 1.0.

600 lbs. of this mix will give 384 lbs., or approximately one barrel, of cement, the balance representing the carbon dioxide, water and sulphuric anhydride which will pass off in gaseous form at the stack temperature.

The heat units required to produce one barrel of cement, with the corresponding coal consumption, under various conditions, may now be calculated as follows.

1. *Continuous Vertical Kiln.* In this method of burning the material is introduced in the form of dry blocks; the clinker is discharged cold after giving up practically all its heat to the air required for combustion, while the gases escape to the stack at a temperature not exceeding 400° F.

	Heat units	% of total
450 lbs. carbonate of lime decomposed @ 765	344.250	88.9
12 lbs. water evaporated and heated 60° to 400°	14.498	3.7
6 lbs. sulphuric anhydride liberated, @ 1,890	11.340	2.8
204 lbs. carbon dioxide and sulphur dioxide heated 60° to 400°, @ .24 sp. ht	16.646	4 6
Total	386.734	100.0

Coal required per barrel cement.

With theoretical air supply ..... 386.734÷12.458=31.0 lbs.
With 1½ times theoretical air supply . 386.734÷12.042=32.1 lbs.
Actually used in practice ..... 42 to 46 lbs.

2. *Rotary kiln, dry material.* In this method of burning the mix is introduced at the upper end of the kiln in the form of dry powder, the clinker is discharged white hot, at a temperature of about 2,500° F. and the gaseous products enter the stack at about 1,500° F.

	Heat units	% of total
450 lbs. carbonate of lime decomposed @ 765	344.250	54.7
12 lbs. water evaporated and heated 60° to 1,500°	20.832	3.3
6 lbs. sulphuric anhydride liberated, @ 1,890	11.340	1.8
600 lbs. mix heated 60° to 1,000° @ .2 sp. ht	112.800	18.0
384 lbs. clinker heated 1,000° to 2,500° @ 2 sp. ht	115.200	18.3
204 lbs. carbon dioxide and sulphur dioxide heated 60° to 1,500° @ .24 sp. ht	24.480	3.9
Total	628.902	100.0

Coal required per barrel cement.

With theoretical air supply ..... 628.902÷9.414=66.9 lbs.
With 1½ times theoretical air supply . . 628.902÷7.651=82.2 lbs.
Actually used in practice ..... 110 to 120 lbs.

3. *Rotary kiln, wet material, (50 per cent water).* In this process the mix is introduced at the upper end of the kiln in the form of a thin mud, and is dried and burned in one operation. The clinker is discharged at about 2,500° and the gases at about 700°.

	Heat units	% of total
612 lbs. water evaporated and heated 60° to 700°.....	827.424	59.3
450 lbs. carbonate of lime decomposed @ 765.....	344.250	24.6
6 lbs. sulphuric anhydride liberated @ 1,890.....	11.310	0.8
600 lbs. mix heated 60° to 1,000° @ .2 sp. ht. less 204 lbs. carbon dioxide and sulphur dioxide reduced 1,000° to 700° @ .24 sp. ht.....	98.112	7.0
384 lbs. clinker heated 1,000° to 2,500° @ .2 sp. ht.....	115.200	8.3
	1.396.326	100.0

Coal required per barrel cement.

With theoretical air supply.....1.396.326×11.630=120.0 lbs.
With 1½ times theo. air supply....1.396.326×10.846=128.7 lbs.
Actually used in practice..... 150 to 160 lbs.

These calculations are, of course, only roughly approximate, as they are based on assumptions which are more or less uncertain, and in some unimportant respects, incorrect. For example, the computation of the heat required to raise the carbon dioxide and sulphur dioxide from 60° to 400° and 700° respectively, assumes these substances to be gaseous at these low temperatures, while as a matter of fact they are in solid form until a temperature of 1,000° or over is reached. The difference in specific heat between these gases and the solids containing them is, however, so slight that this error is insignificant. Further, a certain amount of heat is *liberated* when the lime, silica and alumina of the mix combine, at high temperature, to form basic calcium silicate and aluminate; the amount of heat thus set free is not, however, definitely known.

The first consideration that will occur to the reader in comparing the above figures is the great discrepancy between the calculated amount of fuel and that actually used in practice. This difference is, however, readily accounted for by inferiority in quality of fuel used, moisture and shortage in weight in fuel purchased, irregularity in feed and operation of kilns, loss of material through the stack (often considerable with rotary kilns), loss of product in grinding, admission of more than 50 per cent, excess of air, radiation through the kiln walls, and escape of gases to stack at higher temperatures than those assumed.

Turning first to the continuous vertical kiln, we are struck by the remarkable economy, both theoretical and practical, of this method of burning. The fuel is, in fact, almost perfectly utilized, and it is difficult to conceive the possibility of any practical further saving. As already stated, however, the fuel used in drying the material must be added to that employed in burning before the results of the continuous vertical and rotary kilns can be justly compared.

Considering, next, the rotary kiln used in burning dry material, we find that though the heat units required are only 63 per cent greater than in the vertical kiln, the fuel consumption with theoretical and 1½ times theoretical air is 116 and 156 per cent greater, respectively. This difference is due to loss of heat on account of the high temperature of the rotary stack gases. We have already seen that the escape of the products of combustion of coal at 1,500° reduces its available heating power by nearly 30 per cent, while with gases at 400° the loss is only 7 per cent. Assuming that 1½ times the theoretical air is used, we find

Available heat from 1 lb. coal, gases @ 400°.....	12.042 h. u.
Available heat from 1 lb. coal, gases @ 1,500°.....	7.651 h. u.
Difference.....	4.391 h. u.

Using 82 lbs. coal per barrel cement, we shall have

Excess of heat carried off by gases, 4391x82.....	=360.062
Excess of heat carried off by carbon dioxide etc., from mix ...	53.856
Total per barrel cement.....	413.918

Assuming an output of 8 barrels clinker per hour, and that by means of boilers and engines 10 per cent of this heat could be converted into mechanical power, we find by calculation that 130 horse power might be obtained from each rotary kiln, an amount nearly if not quite sufficient to supply all needs of the factory. Probably only a part of this could actually be recovered; it is evident, however, that an immense economy could be realized from the waste heat of the rotary stacks.

Referring once more to table No. 2, we see that the 384 lbs. of clinker discharged are assumed to be at 2,500° F. If this could be cooled to 60° by means of the air required for combustion of the coal, it would give up to this air 187,392 heat units, or enough to heat the theoretical air supply from 60° to 1,143°, or 1½ times the theoretical air to 932°. The total heat of 384 lbs. clinker corresponds to the heat of combustion of 20 lbs. of coal, or 30 per cent of the fuel required, with theoretical air supply, to burn one barrel of cement. A part of this is, of course, always saved by the heating of the air passing over the clinker as it is discharged. Only part of the balance could probably actually be utilized, yet it would seem that by proper methods all the air required for combustion could be heated by means of the clinker to at least 500°, with saving of not less than 10 lbs. of coal per barrel. At one of the new factories in the Lehigh Valley this operation is carried on in a specially designed clinker cooler, and a fuel consumption of only 95 lbs. per barrel is claimed. With the excess of heat in the waste gases utilized in steam generation, and that of the clinker in heating the air supply, the economy of burning dry mix in the rotary would approach closely to that in the continuous vertical kiln.

If we now consider the figures given for rotary burning of wet mix, we are struck with the great amount of heat used in evaporating the 50 per cent water assumed to be present. This amounts to nearly 60 per cent of the total; the calculated coal consumption is, however, much less than double that of the dry burning rotary, owing to the fact that the stack gases are greatly reduced in temperature; or, in other words, that a part of the drying is done by the waste heat of the burning. If we calculate the quantity of water which the stack gases from dry burning would evaporate in being reduced in temperature from 1,500° to 700°, we find that with 1½ times the theoretical air supply this amounts to 176 lbs., or 23 per cent. A mix with 23 per cent water should therefore show the same fuel consumption in burning as a dry one.

In burning wet material the waste gases are, of course, much too cold for effective use in boilers, and the only practicable method of regaining any portion of their heat is probably the increase of drying surface, by which a reduction of temperature to 500°, or possibly less, ought to be possible. The loss of heat in the clinker is the same as in dry burning, though forming a smaller percentage of the total, (13.4 per cent).

In conclusion it may be said that the increased fuel cost in wet burning is probably more than counterbalanced by the great economy of mixing, grinding and handling the materials in liquid form.

BALTIMORE CEMENT MARKET.

The cement trade has been fair. We are filling contract orders in Baltimore, Washington and New York. We were called upon to supply Akron Star cement for some repairs to the Union railroad tunnel that collapsed last month. It is supposed that the accident may have been caused by a bursted water pipe belonging to the city water supply.

Among the orders received was one from the Brooklyn Navy Yard for one thousand barrels of Bonneville Portland cement intended for export to the Phillippine Islands. This is probably the first order received by a Baltimore firm for cement to be shipped to our new possessions, and it is quite a card for the Bonneville Star brand of cement.

WM. WIRT CLARKE & SON.

BALTIMORE, July 22, 1901.

CONCRETE CONSTRUCTION IN HONOLULU, HAWAIIAN ISLANDS.

Concrete is an eminently suitable material for building constructions for the Hawaiian Islands. The entire absence of clay makes the cost of building with brick excessive. All brick must be imported, while terra cotta when imported must be crated. Stone, likewise, is very scarce and costly; lumber is likewise imported. Concrete, therefore, takes the place of wood, brick, stone and terra cotta.

There are several fine specimens of concrete constructed buildings at Honolulu: The Judiciary Building, erected in 1872–74; the Clark Stables; the Automobile Co.'s Station House and the Post Office Building, the last named building we here illustrate. Mr. C. B. Ripley of Honolulu is doing much to advance concrete construction in the Hawaiian Islands, having spent several months in the states investigating the various systems of concrete constructions, returned to Honolulu and organized the Concrete Construction Co., Ltd., of which he is now president. This company is now doing practically all of the substantial work in the islands. It has issued a pamphlet of 64 pages describing concrete building construction in the Hawaiian Islands and elsewhere, illustrated by half tones.

POST OFFICE BUILDING, HONOLULU.

As there is no sand or crushed stone available in the Hawaiian Islands, crushed lava rock is used instead as an aggregate. This is found on the ocean beach mixed with coral. The lava rock is very dense, partaking of the nature of granite and is therefore eminently satisfactory for making concrete.

The company formed near Florence, Colo., announces that the plant will cost $300,000. Arrangements for placing structural material on the ground are made. By the end of the year at least 100 men will be employed. The capacity of the plant will be 1,000 barrels per day.

G. ADOLF WAYSS PATENT FLOOR AND CEILING CONSTRUCTION.

Our illustration show a new concrete and steel floor and ceiling construction, the steel being in the form of hoop iron which is embedded in concrete.

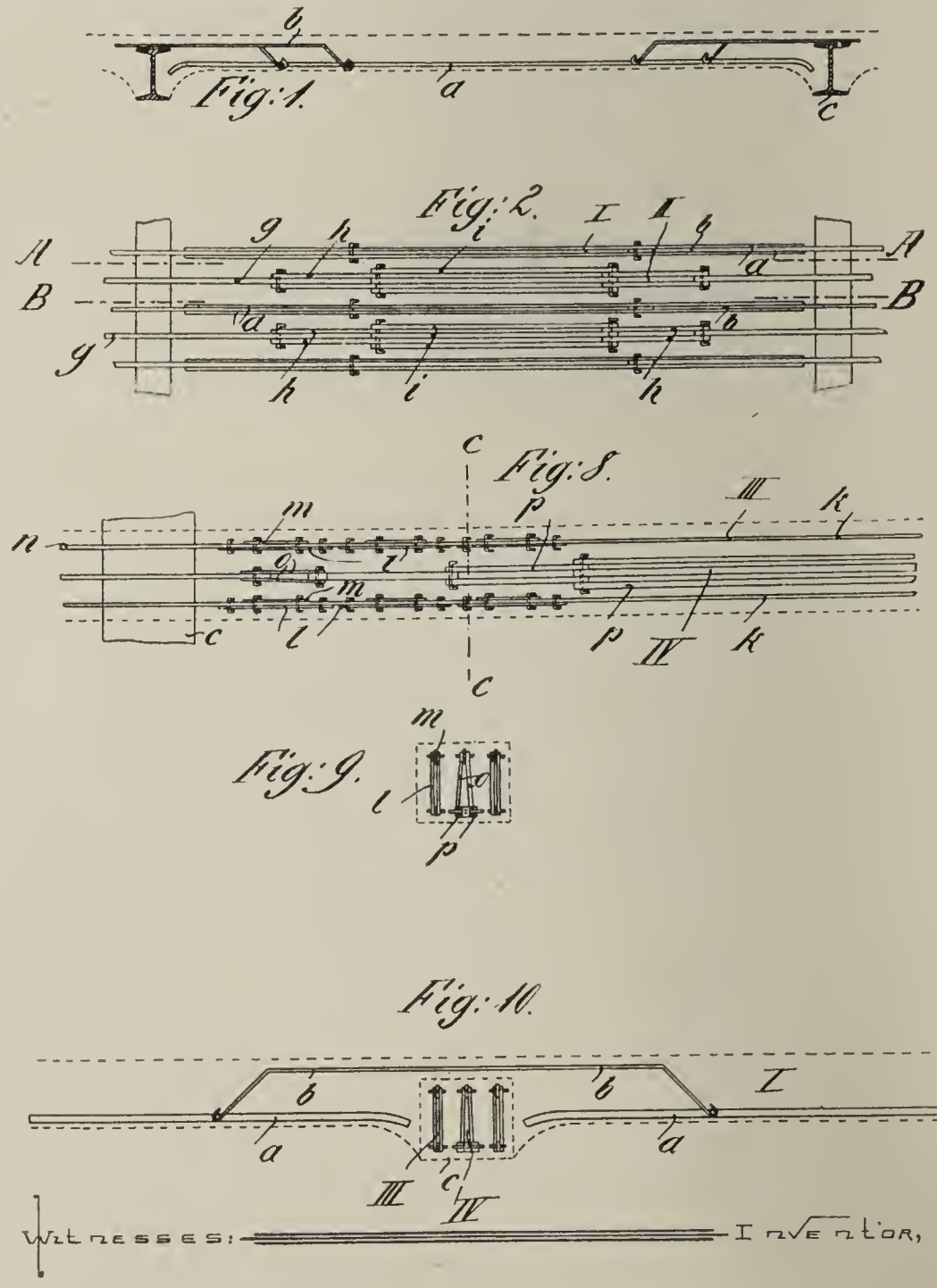
Fig. 1 is a vertical section of a ceiling. Fig. 2 is a plan of the same, The hoop iron is assembled in bundles and connected by bolts as shown in Fig. 2. Fig. 8 shows a beam constructed under the Wayss patents. Fig. 10 shows a ceiling in combination with a beam. The hoop iron may be placed either edgewise or flat. The section of the iron hoop depends upon the weight to be carried. The beam, Fig. 8, may be constructed to take the place of steel I beams in building construction.

The principle claim of the inventor is as follows: Iron and concrete construction more particularly adapted for ceilings, floors and other like parts, having embedded bundles extending from supporting-point to supporting-point, and other bundles arranged between said first-mentioned bundles and not extending from supporting-point to supporting-point and consisting of limbs connected with each other and of greater number at the middle of the construction as compared with the parts nearer the supporting-points substantially as described.

GOOD MARKET FOR CEMENT.

South Africa is a good market for cement. All public buildings, stores, and dwellings are coated with cement. There are very few wooden buildings erected. The masons in South Africa are mostly Malays. They are skilled in their trade and do the work very neatly. Cement is also largely used in the construction of aqueducts, wharves, chimneys, walls, etc. While the principal import of cement is from Great Britain, considerable quantities are also imported from Belgium and Germany, the latter, on account of its cheapness, increasing. Belgium cement is of good quality and as cheap as the English article. The reports state that American cement could compete well, as transportation from our country is not higher than from Europe.

The American Cement Post Co. of Athens, Mich., have their new 200-horse power hydraulic press at work. It presses four posts at a time and can turn out 1,200 in 10 hours.



GRINDING COAL MARL AND LIMESTONE.

Cement manufacturers have long sought an efficient inexpensive grinder for the softer materials used in the manufacture of Portland cement.

Limestone, clay, coal, etc., being comparatively soft, should not require as expensive grinding machines as extremely hard rotary clinker.

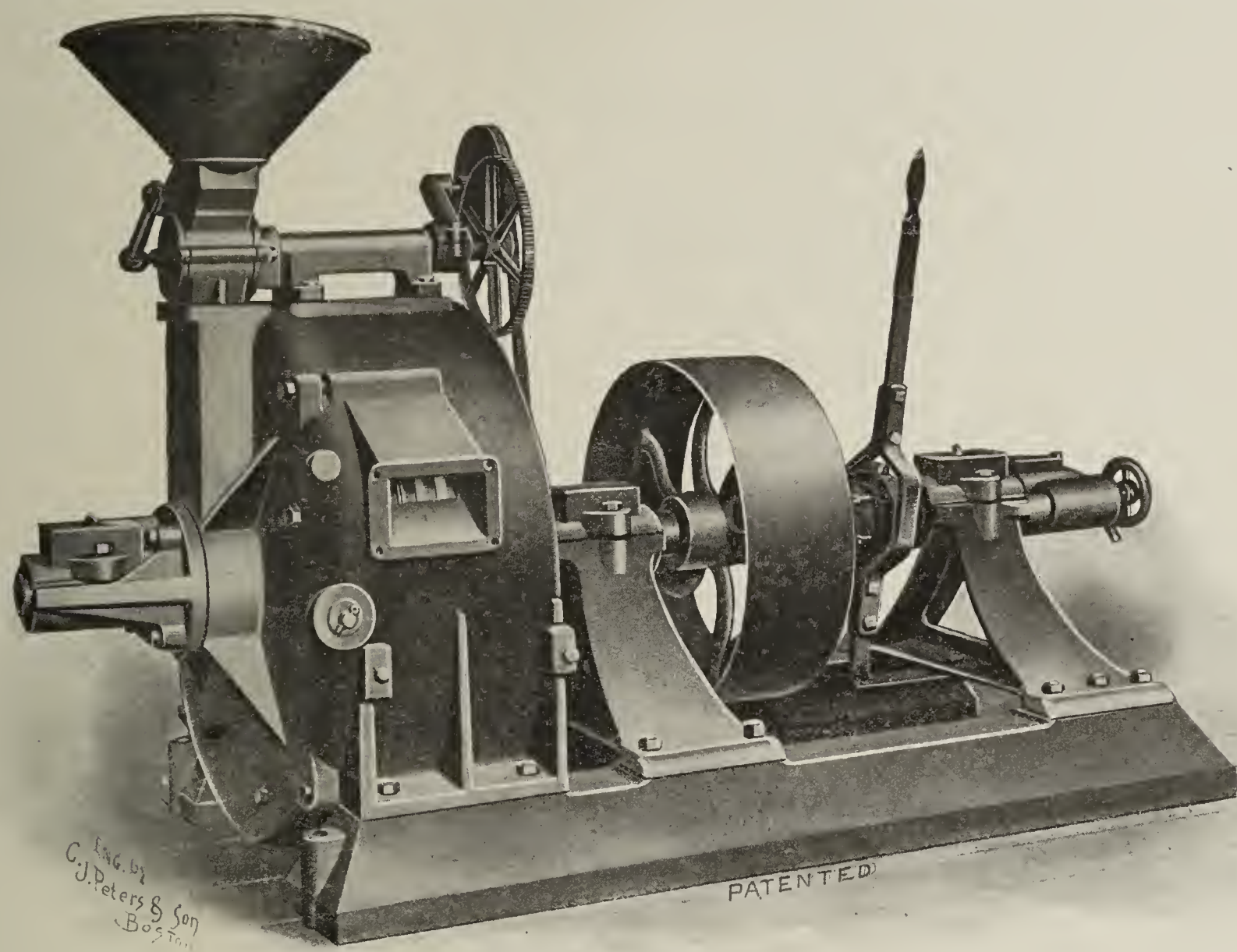
Rock emery mills are largely used for these easier reductions and, while comparatively inexpensive, are always satisfactory. Their one fault has been insufficient capacity.

This has recently been overcome by the Sturtevant Mill Company of Boston, the well known manufacturers of this class of machinery. They now make a vertical rock emery mill at a very moderate price and its immense output has caused its immediate introduction by many large producers.

This machine is shown in the cut and is an improved emery mill of a much larger size than any heretofore constructed. It was designed especially for cement work and is capable of grinding from 5 to 6 tons of limestone or dry marl per hour, and on coal for the rotaries will equal the deliveries of any of the large, expensive iron mills.

Its simple and convenient design commends it to everybody and it can be run by inexperienced men. The wear and tear is almost entirely confined to the emery stones, which are favorably known to thousands for their remarkable durability and cutting properties. Their advantages are well known, and that they are in use in over 1500 works, many of the largest size, and where they have displaced all other grinders, is a sufficient certificate of excellence.

This rock emery mill is self-contained; it delivers a finished product direct from the machine without screens; it needs no foundation other than a good mill floor, and it will run smoothly. The machine is complete, ready for belting, when it leaves the Sturtevant shops.



Its friction clutch stops or starts the mill. It is provided with a special roller feed which supplies a regular amount of material.

The Sturtevant Mill Company has just issued an 80-page illustrated circular fully describing this machine together with many more of its manufacture. It will prove interesting to those who use this class of machinery. The manufacturers will be pleased to forward it on application.

Incorporated: The Great Western Cement Co., capital stock $600,000; object, manufacturing; principal office, 15 Exchange place, Jersey City, N. J.

WIRELESS TELEGRAPHY IN THE HAWAIIAN ISLANDS.

The Marconi system of wireless telegraphy is now established between four of the Hawaiian Islands, viz., Oahu, Molokai, Lauai, and Maui. Experiments have been going on for some time past to find suitable stations on the islands for placing the instruments. Difficulties were met with in this respect, but they have now been overcome, and the new system of communication was made available to the commercial community and the general public on the 2d of March, and has since been in successful operation. The distances between the inter-island telegraph stations are as follows: Oahu and Molokai, 27 miles; Molokai and Lauai, 30 miles; Lauai and Lahaina (Maui), 10 miles; Lauai and Makena (Maui), Makena (Maui) and Mahukona (Hawaii), 43 miles. The latter line is expected to be established very shortly.

A company to construct a belt line system is being formed by the officials of the Hecla Cement Company. The belt line will connect the company's plant with all the railroads running into the Bay Cities (Mich.) and one spur will run direct from the plant to the company's newly acquired mine property in Monitor township.

CONCRETE GRAIN STORAGE BINS.

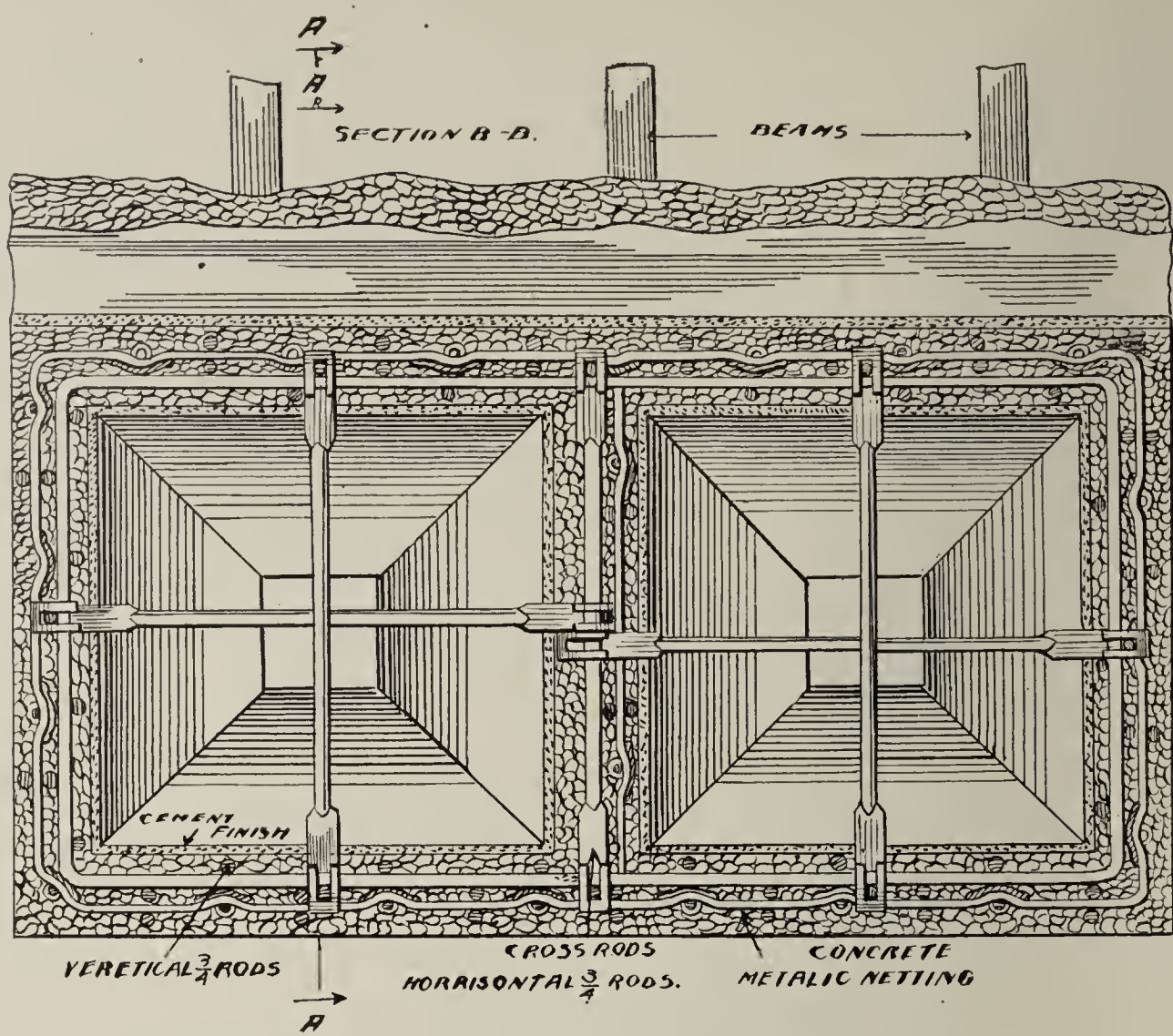
The use of concrete grain storage tanks is becoming quite general with flouring mills, breweries, and large elevators where grain is received for shipment on an extensive scale, by rail and water. Concrete possesses complete fire-resisting properties beyond any other class of materials heretofore used in grain elevator construction, and insurance tariff forms a considerable item of expense both to the owner of the elevator system as well as to the owner of the grain stored. The reduction of this item is, therefore, a strong argument in favor of the use of concrete and is alike appreciated by the insurance companies as well as the insured. We illustrate a new form of concrete grain bins, now being constructed under the Shillinger system, (steel and concrete) for the Wehner Brewing Company, at Dayton, Ohio, to be used for grain and malt storage. The Shillinger Brothers of Chicago are the contractors for the work. The grain storage tanks now under construction are three square tanks or bins 35 to 47 feet high, having a capacity of 3,500 bushels for each tank. The details of construction are shown in the plans and cross-section. The outside finish is in imitation of cut stone; the inside is smooth plaster finish. The Sandusky Portland cement (Medusa brand) is being used throughout the construction of these tanks.

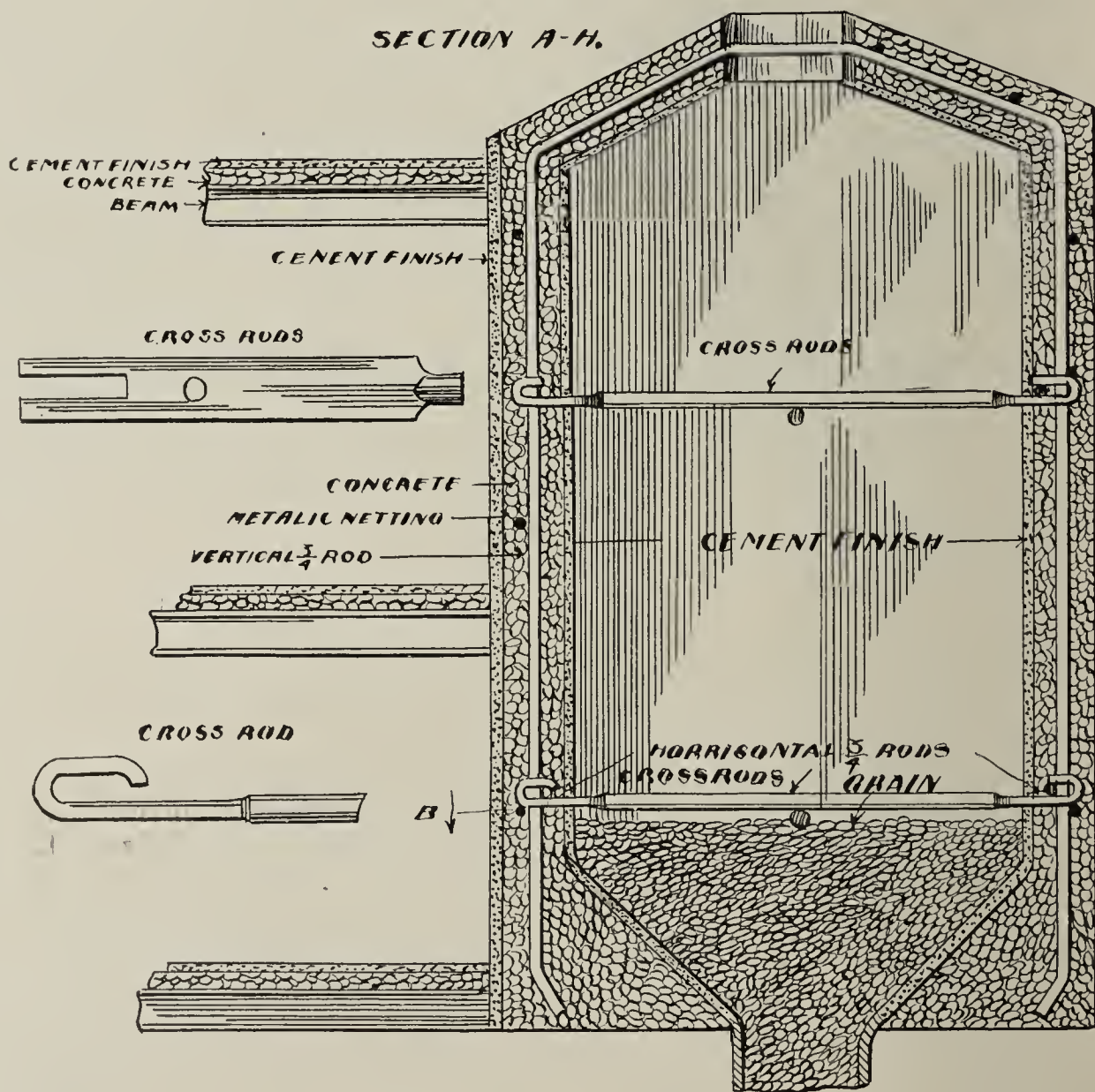
The Newaygo Portland Cement Co.'s product is on the market.

Walter Holstead of Lyons, N. Y. has secured the contract from the New York Central & Hudson River Ry. for building all cement sidewalks required between Buffalo and New York.

Incorporated: National Concrete Company. Principal office, New Jersey, Registration & Trust Co. Building, East Orange, N. J. Objects: To manufacture, buy, sell, use, deal and trade in any and every kind of concrete material. Capital, $100,000. Incorporators: Cleveland V. Childs, James R. Mapletoft and H. N. Smith.

The Equitable Title and Trust company has been appointed receiver of The Marquette Portland Cement Company of Deer Park Glenn, near La Salle, Ill., where its plant is located. The Marquette brand of cement was well and favorably known in Chicago and the West. The assets and liabilities have not yet been definitely stated.

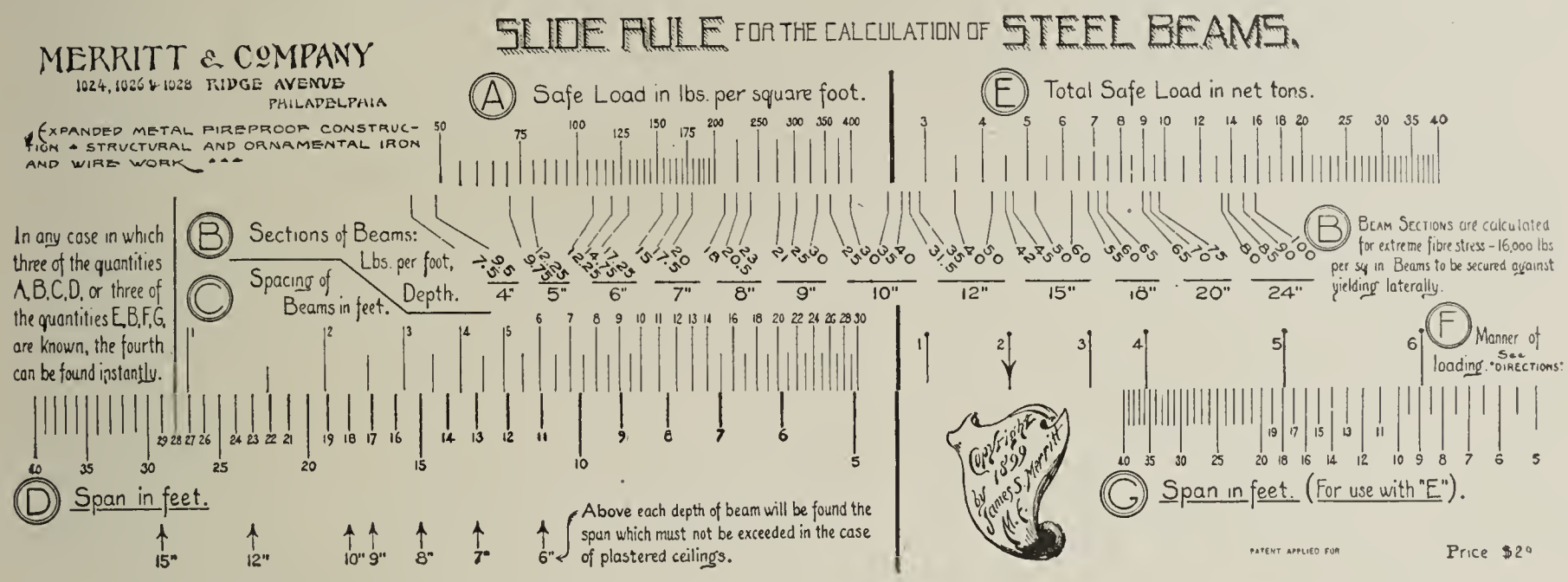




CONCRETE GRAIN STORAGE BIN

MERRITT SLIDE RULE FOR CALCULATION OF STEEL BEAMS.

The Merritt slide rule herewith illustrated was originally designed by James S. Merritt for the use of the Merritt Co. of Philadelphia in calculating structural steel in connection with the expanded metal system of fireproofing. By the use of this instrument all calculation relative to concrete floors and partitions are simplified. The safe load in pounds per square foot for the area covered, as well as the total safe load in net tons and spacing of beam in feet can be found by simply moving the slide under or over the graduations marked on the stationary parts of the instrument. We recommend the Merritt slide rule as an instrument of precision in all calculations for which it is designed. It will be appreciated by architects and engineers as a great labor saving device. We understand it can be obtained from Merritt & Co., 1024 Ridge Ave., Philadelphia, Pa. Price, $2.00.



The Knox county jail at Knoxville, Tenn., will have three floors constructed of concrete, this material being regarded as the most suitable for the purpose, safety, durability and cost being considered.

The Chicago Portland Cement Co. has issued for circulation a 64 page pamphlet, handsomely embelished with half tone illustrations showing heavy concrete masonry constructions, such as railway culverts and abutments, bridge pier foundations, street pavement foundations, curbs, gutters and sidewalks, in which the AA Brand Chicago Portland cement has been used. The history of the works with a full page cut of the plant is given, with numerous letters from consumers testifying to the uniform good properties of this cement. This pamphlet can be had on application to the Garden City Sand Co., Chicago, Ill., the general sales agents of the company.

HOLLOW CONCRETE BLOCKS IN ST. PETERSBURG, RUSSIA.

The Imperial Russian Architects Association at St. Petersburg, Russia, recently discussed the subject of installing a hollow concrete building block plant. A number of private dwelling houses are being erected. The Russian government is likewise using hollow concrete blocks in the construction of barracks for its troops. At Simolna, the Gronowschen Borse has been erected out of hollow concrete blocks. The Minister of the Interior has promulgated through the technical building committee of the empire rules, regulations and general instructions to apply to the construction of concrete dwelling houses in the empire. These regulations have been adopted by the Imperial Russian Architects Association except a slight modification which the association requests the minister to consider and adopt as being more suitable for the production of good work, under the climatic conditions of the empire. Several military hospitals are now under construction on the hollow concrete block system, under the supervision of experts, who will determine whether or not the modifications suggested by the architects are to be adopted.

Application to the Lieutenant-Governor-in-Council has been made for the incorporation of the Ontario Portland Cement Company, Limited, with capital of $450,000. The applicants applying for the charter and signing the petition are: Edward L. Goold, manufacturer; Wareham S. Wisner, manufacturer; Arthur A. Bixell, manufacturer, and W. George Elliott, contractor. The provisional directors are the parties named in the petition, and the head office is to be located at Brantford, Ont. It is the intention of the directors to open their office immediately, sufficient stock having been pledged to warrant such a step.

STEAM HEATED CEMENT WALKS.

The old wooden walks on the campus of the University of Chicago are being removed to be replaced by subways covered with cement vault covers. These subways will be used for housing brick sewers, steam pipes, and electric lighting wires.

These subways will radiate from the power plant to the various buildings on the grounds. The temperature in the subway will be maintained up to a point sufficient to melt the snow and ice on the surface during the winter months.

This new system, the officials think, will put an end to the many protests which have come in regarding the condition of the campus walks. Many of the walks have been almost impassable during the winter months, and students have been compelled to wade through the snow and water, with disastrous effects upon their health.

Students and others connected with the university are greatly pleased at the prospect of having dry walks in winter, and insist that the new idea is a logical outcome of the research work and investigations which are being carried on in the sanitary and physiological departments of the university.

A small cement plant is under construction at Oriella, King county, Washington. Seven men are now employed. The machinery is being installed.

On July 10 the buildings of the Fitzgerald Patent Prepared Plaster Works of Huntington, W. Va. were totally consumed by fire. Loss, $25,000; insurance $8,000.

The Illinois state fair grounds at Springfield, Ill., is being improved by the construction of 8,000 feet of cement walk. The space between the grand stand and the roadway south of it will likewise be paved. This pavement will be 300 feet long and forty-three feet wide..

SPECIFICATIONS FOR CEMENT.

The standard specifications for cement for the Navy Department are as follows:

The cement to be of the best quality of Portland cement, freshly ground, and delivered in canvas sacks, each sack to contain not less than 95 pounds of cement. The sacks to be carefully secured to prevent waste or loss in handling. Sacks to be returned to the contractor from time to time as they are emptied for use in the work. The cement to be delivered at the navy yard in lots of 400 bags each on or before the expiration of 10 days notice in writing to deliver each lot. The first delivery to be made within 10 days after the date of the contract.

Cement of which a constituent part is derived or manufactured from "slag," or which has not been used in the manufacture of concrete in heavy foundation work for more than three years prior to the time of awarding of this contract, will not be acceptable.

Bidders will be required to submit with their bids certified statements that no "slag" has been or will be used in the cement to be delivered under this contract; also a certified statement of the engineer or architect of buildings or structures wherein this cement has been used in the manufacture of concrete in heavy foundation work, and has proven satisfactory in every respect for the period of three years prior to awarding of this contract. Failure to produce either of the above mentioned certified statements will be sufficient cause to reject the cement delivered by the contractors, without further test, and all rejected cement will be immediately removed from the yard by the contractor and replaced with other cement to fully meet these and all other specified requirements and tests, without cost to the government.

A certified chemical analysis of the cement to be delivered under this contract must be supplied by the contractor prior to the first delivery of said cement.

All cement as delivered will be immediately subjected to the following tests by the civil engineer in charge of the work; failure of the cement to fully meet each and all of the hereinafter described tests will cause rejection of the cement, which must be immediately removed by the contractor and replaced by other cement of a quality to meet the requirements and tests, without cost to the government:

Specific Gravity and Fineness—Portland cement shall have a specific gravity of not less than 3.1, and shall leave, by weight, a residue of not more than one per cent on a No. 50 sieve, 10 per cent on a No. 100 sieve and 30 per cent on a No. 200 sieve. The sieves being of brass wire cloth, having approximately 2,400, 10,200 and 35,700 meshes per square inch; the diameter of the wire being 0.0090 inches, 0.0045 inches and 0.0020 inches, respectively.

Constancy of Volume—Pats of neat cement, 3 inches in diameter, ½-inch thick, with thin edges, immersed in water after "hard" set, shall show no signs of "checking" or disintegration.

Time of Setting—It shall require at least 30 minutes to develop "initial" set; this being determined by means of needles from pastes of neat cement of normal consistency, the temperature being between 60 degrees and 70 degrees Fahrenheit.

Tensile Strength—Briquettes of cement 1-inch square in cross section, shall develop the following ultimate tensile strengths:

24 hours (in water after "hard" set), 150 pounds.

7 days (1 day in air, 6 days in water), 450 pounds.

28 days (1 day in air, 27 days in water), 550 pounds.

7 days (1 day in air, 6 days in water) 1 part of cement to 3 parts of standard quartz sand, 170 pounds.

28 days (1 day in air, 27 days in water) 1 part of cement to 3 parts of standard quartz sand, 240 pounds.

STOCKHOLDERS MEETING.

The special meeting of bondholders and stockholders of the Michigan Portland Cement Co. was held at Coldwater, Mich., July 16th. The meeting was called on account of the non-payment of the interest on the bonds which was due July 1. A statement was issued at that time stating that on account of expensive repairs and the low price for cement the semi-annual interest could not be met. About fifty of the stockholders from all parts of the state were present, and $685,000 of the bond issue of $1,000,000 was represented. E. D. Johnston of Calumet, offered the following resolution, which was adopted by a large majority:

"Resolved, That a committee of five be appointed by the chair to formulate a plan of reorganization along the lines outlined by the proposition submitted by Mr. Warren of Detroit. The following is the proposition: The corporation is at present organized with a capital stock of $2,500,000 and has a bond issue secured by a mortgage of $1,000,000. It is proposed to reduce the capital stock of the corporation to $2,000,000, $1,000,000 of which shall be first preferred, approximately $200,000 second preferred and approximately $800,000 common stock; the preferred stock, both first and second, to be entitled to 6 per cent cumulative dividends; the first preferred to be a first lien upon the assets of the corporation in the event of liquidation and to be entitled to its dividend before the second preferred shares in any dividend; the second preferred stock to be a second lien in case of liquidation and to be entitled to a dividend after the dividends on the first preferred shall have been paid. The preferred stock to be issued in exchange for the present outstanding bonds of the corporation. A like amount of preferred stock to be issued to the present holders of the bonds for a like amount of bonds. The second preferred stock to be issued for the purpose of taking up the indebtedness due by the company to the American Construction Company, now evidenced by the notes of the company, a dollar's worth of second preferred stock being given for each dollar's worth of indebtedness. The common stock of the corporation to be issued to the holders of the present stock of the corporation in such proportion as $800,000 bears to $2,500,000; preferred stock, both first and second, and common stock to be entitled to vote at all stockholders' meetings."

The following committee was appointed: E. D. Johnston, Calumet, Mich.; L. M. Wing, Coldwater; R. H. Munson, Bay Mills; H. H. Barlow, Coldwater, and A. C. Raymond, Detroit. The claims of the managers are that with sufficient working capital and both the Coldwater and Quincy plants running full capacity good results can be shown.

The Iola Portland Cement Co. has declared a dividend of 8 per cent.

The German Portland Cement Co. of White Pigeon, Mich., is under construction.

The Mutual Oil & Asphalt Co., capital $150,000, has been chartered at Austin, Tex., by H. C. Holcomb, Jefferson Johnson and others.

The contract for the building of cement sidewalks in Bay City has been awarded to the McLaughlin Coal & Lime Co. of Bay City, Mich.

The Elk Rapids Portland Cement Company of Elk Rapids, Mich., has temporarily shut down pending the installation of new machinery and overhauling the old. Seventy per cent of water is now required in the slurry as it enters the rotary kilns which adds greatly to the cost of manufacture. The company has a large quantity of cement on hand and will, during the shutdown, continue to supply the trade. When the plant starts up it will have a largely increased capacity with the certainty of cheaper production.

ALCOHOL VS. COAL IN GERMANY.

According to a German technical publication, alcohol can not be profitably used for making steam.

One kilogram (2.2046 pounds) of coal, costing 2½ pfennigs (0.6 cent), the paper says, produces from 7,000 to 8,000 caloric units, while 1 kilogram of alcohol, valued at 22 pfennigs (5 cents), produces only 6,000 units. In spite of the number of good alcoholic lamps on the market, alcohol is only used where a very strong light is necessary without reference to economy. Only in one instance is alcohol preferable to coal or benzine, and that is in motors run on the explosion principle. Alcohol leaves no residue in the motor and from 23 to 24 per cent of its heating power is utilized, while steam utilizes only 13 per cent, and benzine, petroleum and gas from 14 to 18 per cent.

As the number of minor establishments requiring relatively small power is constantly growing, alcohol motors are in demand. The automobile industry has lately given preference to alcohol motors, especially in the construction of freight automobiles. The price, in Germany, of alcohol for motor purposes is at present $4.80 for 110 quarts.

BOOK NOTICES.

Frank L. Crobaugh, M. S. of Cleveland, O., professor of chemistry Cleveland Homeopathic Medical College, member the Cleveland Chemical Society, proprietor the Foundryman's Laboratory, has written a treatise on methods of chemical analysis and foundry chemistry. Now in preparation, ready August 20. Price, $1.50.

A B C of the Telephone by J. E. Homans, 333 pages illustrated, 7x5 inches. Theo Andel & Co., 63 Fifth avenue, New York. Price $1.00. A complete practical treatise on the construction, installation and operation of the telephone with nearly 300 diagrams and sectional drawings and high class illustrations. Clearly written in simple language, so that he who runs may read and understand, the information is sufficiently full and precise to make the work useful for reference.

The Cement Industry; being a description of various Portland and natural cement plants in the United States and Europe, 235 pages, illustrated. Published by the Engineering Record, New York. Price, $3.00. This book contains the most complete detailed description of methods and machinery employed in the manufacture of Portland cement that has appeared in the English language. It minutely describes and illustrates modern American methods of Portland cement manufacture. A concise description of numerous German, Belgian and English Portland cement plants is given. Numerous plans of the installation of machinery are shown and fully described. Several of the plants described have been completely overhauled and the system of manufacture changed since the first publication of the articles in the Engineering Record, therefore the description recorded in the book will not apply to these particular plants as they exist to-day. This is to be expected, since radical changes in the installation of machinery are frequently made in cement plants to conform to local requirements of the raw materials or to the change or ownership and management. This book should be in the hands of all persons desiring to familiarize themselves with the American process of manufacturing Portland cement.

The Department of Public Works of South Bend, Ind., is advertising for cement curb and gutter work.

The Atlas Portland Cement Co. is doing some preliminary work on the site of its proposed plant near Hannibal, Mo.

The Cement Post Co. of Marshal, Mich., has filed articles of association and will soon begin manufacturing a cement post recently patented by John Martin of Marengo, Mich.

A general assignment has been made by the Consolidated Wheatland Plaster Co. of Mumford, N. Y., to Arthur Luetchford. The company mined and ground gypsum and other ores.

The Michigan state labor bureau is preparing to send out canvassers to investigate the cement and beet sugar industries of that state. Inquiries will be made with reference to wages paid, the number of hands employed, etc.

Some cutting of prices in New York City, July 17th, were reported in the cheaper grades of cement, but standard grades of Portland are firm at $1.65@1.80. Supplies at the mills are reported to be low, while demand is good.

The Standard Fertilizer Manufacturing Company of Virginia is negotiating with the Bessemer Land and Improvement Company, Birmingham, Ala., for a site to manufacture slag cement and fertilizers out of slag. The company will need twenty acres. It has a capital of $250,000 and will employ a large number of skilled hands. Every encouragement possible will be given the company to locate at Birmingham.

The sales department of the Michigan Portland Cement Co. has been removed from Chicago to the general offices of the company at Coldwater, Mich. All communications should be sent to the new address.

Mr. James S. Merritt, of Merritt & Co., Philadelphia, Pa., read a paper on "Expanded Metal in Fire-Proof Construction" before the Engineers' Club of that city. The paper appears in the July issue of the proceedings of the club.

The United Cement Masons' Union No. 1 of New York has notified the bosses that after September 1, 1901, a demand of 55 cents per hour for all cement masons will be made, and will further demand an 8-hour day.

Belknap's, Speed's and the United States cement mills are the only ones of the large number in Clark county, Ind., now in operation, and their running is limited. The combine did not prove beneficial, it is alleged, and it is likely to be broken.

The J. B. Ford Co. of Wyandotte, Mich., has contracted with the Ginzel Paving Co. of the same place for 150,000 feet of cement sidewalk to be laid on the company's new real estate allotment known as the Alkali Subdivision and located at Wyandotte.

Augustus J. Mayworm, C. E., was accidentally killed at the plant of the Alpena Portland Cement Works on July 13th, while attempting to repair one of the clay conveyor pipes. Mr. Mayworm was a graduate of the civil engineering department of the University of Michigan.

The Cement Factory of Jas. Morgan & Co. at Longue Pointe, Quebec, was destroyed by fire on July 7th. There was no water in the neighborhood and the firemen were unable to extinguish the flames. The damage is estimated at $30,000, of which $10,000 are on the contents and $20,000 on the building. Against this the firm is said to carry an insurance of $15,000.

The cement foundations supporting six steel columns in the New York subway, now under construction, gave way July 19. The sub-contractor asserted that the cement had been tested and was first-class in every respect. The accident was probably due to the trouble lately with labor unions. The contractors had hired non-union med as cement mixers and it is claimed that these men did not know how to mix the cement, putting in too much sand. The break is not considered bad enough to cause any serious delay in the completion of the work. The contractor, however, is anxious about the strength of the other cement beds already finished.

The Portland Cement Co. of Utah has executed and filed a trust deed on its plant, property and sundry mining claims in favor of the California Title & Insurance Co. The trust deed is to be given as security for an issue of bonds in the sum of $10,000.

The Wellston Portland Cement Co. has authorized an issue of $75,000 worth of bonds, to secure a mortgage of that amount on the company's plant at Wellston, O., the Detroit Trust Co. acting as trustee. The bonds will carry 6 per cent interest, but will run for only five years. Of the total issue $50,000 in bonds will be issued at once, and the remaining $25,000 when the money may be needed.

Wherever the Romans penetrated they were sure to erect great baths. Recent excavations on an estate in Scotland have revealed the foundations of an immense bath with concrete floors and walls, lead-pipe connection, hypocaust and stoke-hole with a flue extending from it, says *The Architect*. The foundations of the piers in the hypocaust are now displayed. The walls of the rooms are formed of stone and lime covered with strong concrete, with a polished surface and painted a brick-red color. The floors are all of concrete.

Articles incorporating the National Concrete Co. were recorded to-day in the office of the county clerk. The principal office will be at 525 Main street, East Orange, and the New Jersey Registration & Trust Co. will be the legal agent. The objects of the concern as set forth are to manufacture and deal in all kinds of concrete materials. The capitalization is $100,000 divided into 1,000 shares of the par value of $100 each. Business will be begun with $1,000 which has been subscribed by these incorporators: Cleveland V. Childs, eight shares; James R. Mapletoft, one share, and H. N. Smith, one share.

It is very probable that the large cement mill near Florence, Colo., will change hands shortly as a large Eastern syndicate, interested in the cement business, has its agent, John H. Ray of Chicago, negotiating for its purpose. Mr. Ray has inspected the plant carefully and is more than pleased. The limitless quantity of shale, from which the cement is manufactured, impressed him very favorably. With this deposit it is entirely unnecessary to import a pound of material from other places, all the essential ingredients necessary being in the shale bed. This deposit is estimated to be large enough to supply the works for 1,000 years. The plant was constructed and equipped at a cost of about $75,000.

Frank L. Packard, architect, is preparing plans for a concrete dwelling house and studio for Clarence White of Newark, Ohio. It will be one of the most artistic dwellings in the state. Mr. White has an international reputation as a water color artist and is the owner of one of the finest private art collections in this country.

The San Francisco Cement Workers' Union has elected the following officers: President, O. A. Tveitmoe; vice-president, Jeremiah Foley; recording and corresponding secretary, M. J. Kelley; financial secretary, William Best; treasurer, T. K. Ryan; marshal, Henry Tyke; sergeant-at-arms, William Cosbie; executive board—William Mahoney, George Barnaby, Emil Johnson, T. Morrisey, James Powers, E. F. Bailey, John Eller. Finance committee—Henry Ullner, A. Anderson, John Sauter; business agent, T. K. Ryan; trustee Progressive Planing Mill, M. J. Kelley; trustee Labor Temple Association, John Pygeorge; delegates to the Building Trades Council—O. A. Tveitmoe, M. J. Kelley, T. K. Ryan, E. F. Bailey and William Best.

The steamer "Tiber" carried 6,000 barrels of mixed Canadian cement (Citadel brand) from Montreal to Sydney, Cape Breton, Nova Scotia, for the Dominion Iron & Steel Co. This is the largest single shipment out of Montreal harbor. Importers and agents of foreign cements say that trade is slow, and that their sales are in small lots. Manufacturers of the home product say that they are as busy as they can be and that their contracts are large and their output constantly increasing. Prices remain steady, German cement being quoted at $2.35 to $2.50 a barrel; English at $2.20 to $2.30; Canadian Silica Portland, $2.10, and Belgium at $1.75 to $1.95. Of foreign cement, the fine German quality meets with the best demand.

The Zenith Portland Cement Co. now under construction near Grass Lake, Mich., will consist of a main building 560x100 feet; a boiler and engine room 240x85 feet; and store room 140x85 feet. The contract price of the foundation work, exclusive of the cost of stone and cement, amounted to $33,500. While all the contracts for the completed mill have been awarded, work is now at a standstill on account of the non-arrival of structural iron, although the company's order has been placed for months. When the iron and steel work arrive operations will be pushed. Chas. Howind of Ann Arbor, has the contract for the brick work. The mill will have eight rotaries and four Griffin mills. The plant will be in full operation in less than a year.

The Infusorial Earth Manufacturing Co. of Virginia has been incorporated, with authorized capital of $250,000, and will establish in Virginia, on 400 acres of land containing deposits of infusorial earth, etc., a plant for manufacturing infusorial-earth bricks, plastic cement and other materials. Wm. Montgomery, Jr., is president, and Wm. G. Menchine, secretary-treasurer, both of Baltimore, Md.; Gardner W. Kimball, chairman executive committee, Wilmington, Del.; Francis McCauley chief and constructing engineer, Philadelphia, Pa.; Frank A. Knowles, superintendent of manufacture, Baltimore, and Francis B. Bishop, chemist, Washington, D. C. Offices at 210 East Lexington street, Baltimore.

We learn that Mr. E. Lee Heidenreich, head of the Central Technical Bureau for Monier constructions, has engaged Mr. P. Grohs as superintendent of construction. Mr. Grohs was for years engaged with the Technical Bureau for Monier Constructions in Germany under Mr. Wayss, and was actively engaged on the Monier railway bridge at Duesseldorf in 1878, and has since been in charge of construction of a number of tanks, sewers, bridges and floor systems throughout the German Empire. The Monier floors at the Illinois Steel Company's works at South Chicago around furnaces Nos. 9 and 10 are finished and in use, and the sight of an arched ceiling where the beam flanges are entirely covered from view is a decided novelty. Mr. Heidenreich and Mr. Grohs leave in a few days for New Orleans to install seven large grain receiving tanks in the Illinois Central new monster elevator.

The Stettiner Portland Cement Co. suffered an over-production in 1900, due to the enlargement of old works and the building of new plants in Germany, also to the close money market which restricted building operations and lessened the demand for cement, causing a decline in cement prices, while there was a considerable advance in the price of coal, and consequently a higher cost of cement production. High freight rates to Berlin, Sachsen, etc., reduced trade at these points. The company employs 600 hands, average wages, 2.75 to 3.25 marks (66 to 78 cents) per day. The dividends for 1900 were 20 per cent, against 22 per cent in 1899. The Star (Stern) Portland Cement Works report 10 per cent less production in 1898 and 1899, with a fall in prices. Trade with the United States fell off. The higher tariff levied by Austria and Russia on cement cut trade with these countries. German wages remained the same as in former years.

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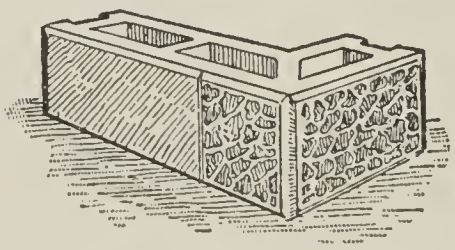

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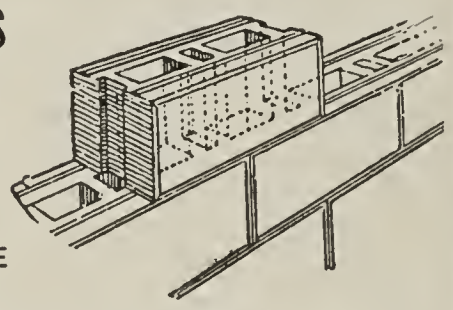

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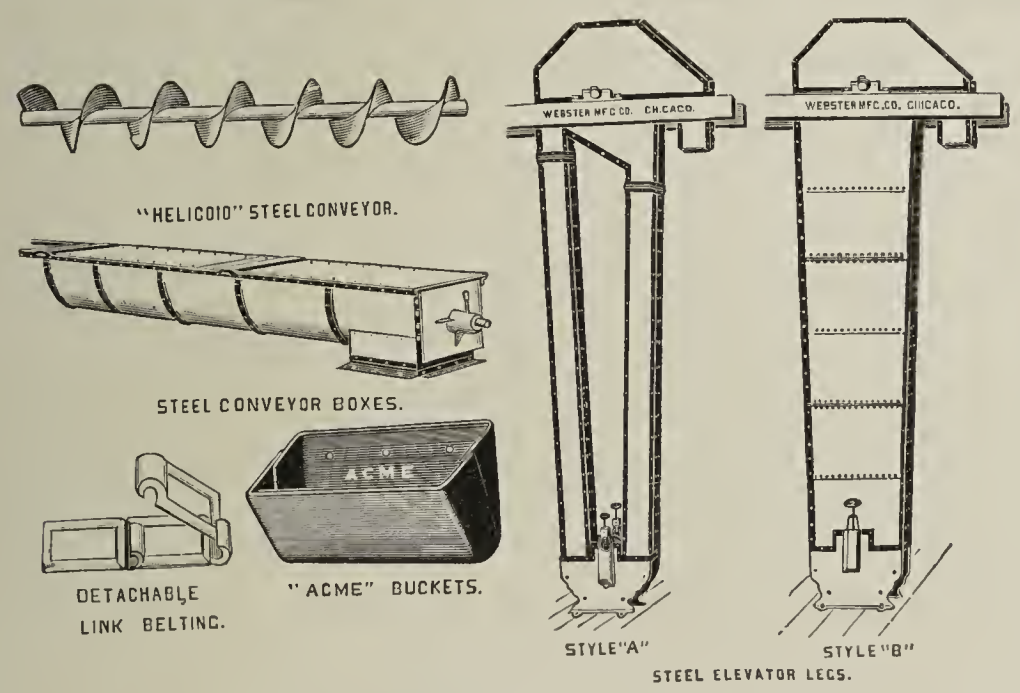

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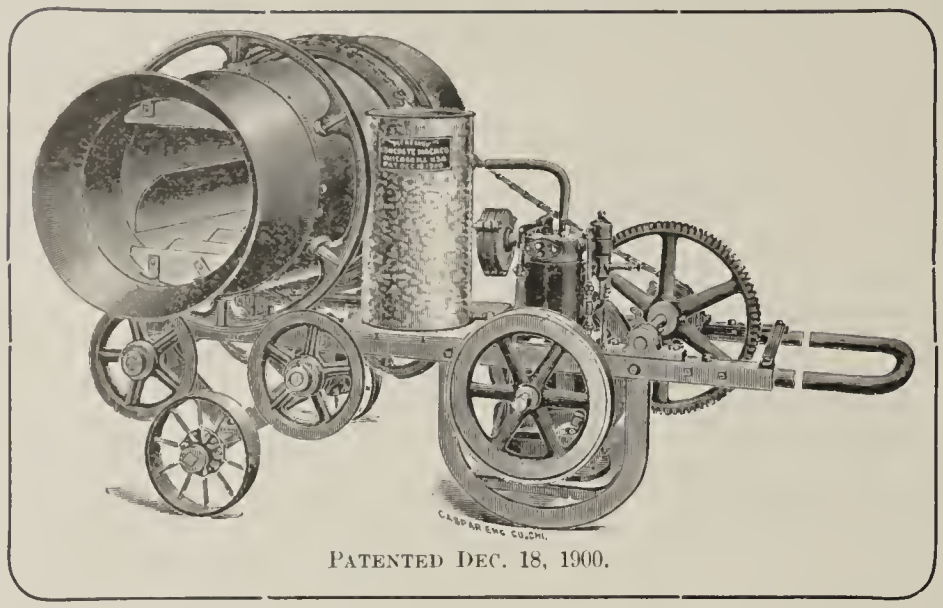

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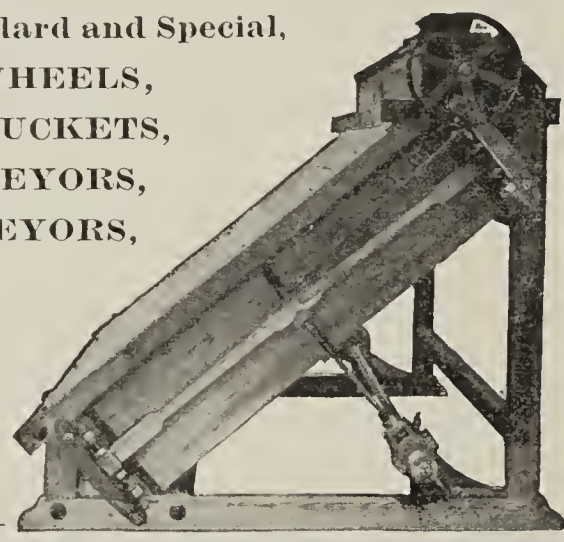

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The cement roofing tile industry is still in its infancy in the United States. There is considerable business being done in burned clay roofing tile, while there are only two factories producing cement roof tiles; one capitalized at $250,000, does such an extensive business that its agent in Chicago has been compelled to turn down single orders to the value of $4,000 simply because the supply was not up to the demand.

The cement roofing tile industry presents a safe, remunerative and inviting field for legitimate enterprise. There are several processes of manufacture, the hand and the machine process both turn out good work. Compared with burned clay roofing tile, the cement tile can be manufactured cheaper with truer lines and with less capital. When made by hand the cement tile are molded in stamped sheet metal forms, to be had in Germany. An outfit to manufacture by hand can be purchased at from $50 to $175 while a single power press will cost $750 laid down in New York.

Sand and cement mixed into mortar are the only materials required for plain tiles. Where one or more colors are desired an extra mill for grinding the cement and color will be required for extra fine work. The manufacture of cement roofing tile in Germany, France and Austria is carried on with extensive capital in sharp competition with the burned clay tiles which it is rapidly displacing. In the Rhine provinces burned clay tiles have been forced down 10 per cent in price. Germany and France do a large export business in roofing tile into neighboring European countries, as well as Cuba, West Indies, South America and into the Southern states of our own country.

Cement tile is capable of high artistic treatment by the use of composite molds by means of which durable colored designs are run into the face of each tile conforming to the design of the architect. Where only a single color is to be given to a tile the coloring matter is sifted over the tile before the cement has set. Considering the small capital required, the ready sale in large cities and the handsome profit in the business, it is a matter of surprise that the cement roofing tile industry has not already assumed larger proportions.

This new field will bear close investigation by every one engaged in the use of Portland cement.

A valuable rock cement has been discovered on the farm of Thomas P. Buchanan, near Saltville, Smythe county, Va. It has been analyzed by a chemist of New York, who pronounces the material high grade natural cement rock.

A NEW FUEL GAS.

We direct attention to an article on another page describing a new process for the manufacture of a high grade fuel gas after the process of Dr. Ludwig Mond of Bruner, Mond & Co., Norwich, Eng. It is claimed this gas can be produced at 4 cents per thousand cubic feet, by the recovery of 90 pounds of sulphate of ammonia, valued at $1.94, from each ton of coal used in the manufacture of the gas. The process is now in use for roasting ore, melting glass and in open-hearth steel furnaces in England. This gas should solve the question of cheap fuel for Portland cement works.

Application for a charter is now pending in the House of Parliament under which five stations are to be established in London to supply manufacturing districts with the Mond gas.

The Western Portland Cement Co. has been incorporated in New Jersey. It will have a capital stock of $2,000,000, of which there will be 10,000 shares of 6 per cent, non-cumulative preferred stock and 10,000 shares of common stock. The incorporators are E. J. Dudley, Robert G. Martin, R. Newman, Horace S. Gould and K. K. McLaren. The charter of the company permits it to deal in and manufacture cement. The intention of the company is to manufacture cement in Western states and that a number of plants already in operation will be absorbed. Strong financial interests, it is said, are back of the company.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	JUNE.				TWELVE MONTHS ENDING JUNE.			
	1900.		1901.		1900.		1901.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	3,871,364	14,692	301,136	1,104	95,778,264	377,530	60,423,272	234,668
Belgium..	37,801,158	121,115	4,267,444	11,985	297,704,778	873,816	203,178,173	630,580
France	. .....	.....	.....	.....	6,182,997	23,946	12,695,758	46,116
Germany.....	58,541,942	219,843	21,160,714	75,412	508,909,816	1,876,956	321,140,079	1,150,020
All Other Europe ...	1,857,200	5,422	1,754,000	4,405	27,195,262	86,170	23,935,820	69,448
British North Am...	208,100	984	133,875	723	1,461,990	7,839	2,217,535	11,193
Other Countries.....	752,420	3,252	562,500	2,450	5,335,580	24,659	6,681,891	27,865
TOTAL	103,032,184	365,308	28,179,669	96,079	942,568,687	3,270,916	630,272,528	2,169,890
Domestic Exports of Cements, bbls.	5,934	13,194	30,300	57,962	76,055	163,162	218,240	438,915

There were 10,406,211 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on June 30, 1900, valued at $36,145, against 8,253,531 lbs., valued at $26,318 on June 30, 1901.

Imports of asphaltum or bitumen for June, 1900, were 8,518 tons valued at $42,343; June, 1901—8,559 tons valued at $50,178. For twelve months ending June, 1900, 106,162 tons valued at $363,291; for twelve months ending June, 1901—136,440 tons valued at $497,194.

ENGINEERING COMMISSION OF THE DISTRICT OF COLUMBIA.

CEMENT TESTING.

Inspection.—Cement will be sampled after delivery. In all cases the seven days' test herein provided will be made before final acceptance.

All tests will be made by the methods prescribed by the committee of the American Society of Civil Engineers, with such modifications as are employed in the laboratory of the Engineer Department, and which are open to the inspection of contractors. All cements will, from time to time, be subject to chemical analysis, and must show freedom from any foreign substance or deleterious matter, and that the elements are combined in proper proportions to secure the best results and insure permanency. All cements must be of uniform quality and satisfactory to the engineer. No cement shall contain over two (2) per cent of sulphuric acid (SO_3).

NATURAL CEMENT.

Fineness.—Not less than 95 per cent to pass a 50 mesh sieve, and not less than 82 per cent through a 100 mesh sieve.

Time of setting.—Initial set in not less than ten nor more than thirty minutes, when mixed with the smallest possible amount of water between the temperatures of 70° and 80° F.

Tensile strength.—One day (in air till hard set, rest of day in water): Neat 80 pounds. Seven days (in air one day, in water six days): Neat 150 pounds; 2 parts sand, 80 pounds. Twenty-eight days (in air one day, in water twenty-seven days): Neat 200 pounds; 2 parts sand, 150 pounds.

PORTLAND CEMENT.

Fineness.—Not less than 95 per cent to pass a 50 mesh sieve, and not less than 90 per cent through a 100 mesh sieve.

Time of setting.—Initial set is not less than forty-five minutes, when mixed with water under the same conditions as with natural cement, except where a quick cement is desired, in which case the time of set will be given by the engineers.

Tensile strength.—One day (in air till hard set, in water rest of day). Neat 225 pounds. Seven days (in air one day, in water six days): Neat 450 pounds; three parts sand 175 pounds. Twenty-eight days (in air one day, in water twenty-seven days): Neat 550 pounds; three parts sand, 225 pounds.

When made neat into wedge-shaped pats about three inches upon a side, half an inch thick at back tapering to a feather edge, the cement must show no signs of cracking or warping after being in air or water at normal temperature for twenty-eight days.

Any cement which shows signs of swelling after being mixed will be rejected.

All cements must be properly seasoned; too fresh cement, or stale cement will be rejected.

The tests in the above specifications will be performed in the manner given below:

Sampling.—About 500 grams of cement are taken from every tenth barrel, the object being to get a ten per cent sample. Each sample is put into a separate bag, numbered, and tested individually.

Fineness.—The fineness is determined by passing a weighed quantity (usually 100 grams) of the cement from each bag through a No. 50 or a No. 100 standard wire gauge sieve and weighing the residue.

Mixing.—For each neat cement briquette 150 grams of cement are weighed from each bag and sufficient water added (from a graduated cubic-centimeter cylinder) that after being thoroughly incorporated the mixture will show water on the surface after being troweled.

The percentage of water is calculated from the number of cubic centimeters of water used, the air, the water and cement being the same temperature, between 70° and 80° F.

For each sand briquette standard quartz or approved sand is used; 2 parts sand by weight are used for the natural cements and 3 parts by weight for Portland cements. In either case the sand is weighed and mixed dry with 1 part by weight of the cement; then sufficient water is added that after being thoroughly incorporated the mixture will just show water on the surface after being troweled, the amount of water being noted and the percentage calculated in the same manner as with the neat cement.

Molding.—After the cement has thoroughly mixed it is placed as a compact mass into the molds and pressed in by a steady pressure of the trowel without ramming; it is then struck off level with the face of the mold and placed on a slate slab to set.

Time of setting.—The initial set is the time required by the cement in the neat briquette (after being placed on the slab) to harden sufficiently to support a one-fourth pound weight supported on a wire one-twelfth of an inch in diameter.

The hard set is determined by placing the cement, after it has obtained its initial set, under a damp cloth until it has hardened sufficiently to support a one pound weight supported on a wire one twenty-fourth of an inch in diameter.

Tensile strength.—Twenty-four hours neat: After a briquette has obtained its hard set it is then removed from the mold and placed under water at a temperature between 70° and 80° F. until the expiration of the twenty-four hours from the time of mixing, when it is removed from the water and broken at once in a Riehle 1,000 pound machine.

Seven days neat and seven days sand. Under the same conditions as with the twenty-four hour test, except that the briquette is allowed to remain under the damp cloth until the expiration of twenty-four hours from the time of mixing, when it is removed from the mold and placed under water for the remainder of the seven days.

Test for checking.—Pats are made from each bag of the neat cement being mixed in the same manner as the neat cement briquette, and placed on a glass slab. These pats are about three inches upon a side and one-half inch thick at the back tapering to a feather edge.

The pats are then placed under a damp cloth until hard set, when one-half of them are placed under water with the briquettes and the remainder left in air. Both are examined from day to day for the development of cracks or signs of warping.

A record is kept of all cements tested, each sample being numbered when received and the result of same being noted in a record book kept for that purpose.

A NEW ENTERPRISE FOR ST. LOUIS.

The St. Louis Portland Cement Co. has been incorporated at Jefferson, Mo., with $1,850,000 capital. In this company are some of St. Louis' wealthiest and most progressive men. The company will erect at Prospect Hill, one mile North of Baden, one of the largest and finest Portland cement plants in the United States.

The consumption of Portland cement in this country has trebled in the past ten years and we have scarcely yet seen the beginning of the industry.

The new company starts off under exceptionally favorable conditions and will be a great addition to the industries of the city. The officers and directors of the company will be: Edwards Whitaker, S. W. Fordyce, J. C. Van Blarcom, E. E. Paramore, Chas. B. McClure, F. R. Bissell, John Scullin, Chas. B Stowe and John C. Robinson.

The manufacture will be under the charge of Mr. Robinson, who has for a number of years been the manager of a plant of this character at Sandusky, Ohio.—(St. Louis Paper).

The St. Louis Portland Cement Co. owns over 400 acres of raw materials of the finest quality for the manufacture of cement, with coal on the property.

MOND FUEL GAS.*

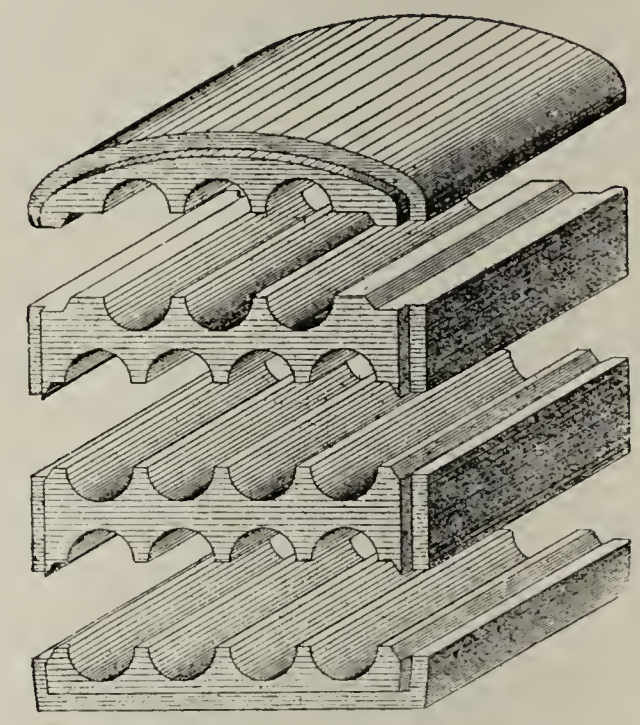
The possibility of using cheap fuel and of recovering its ammonia has been the subject of Dr. Mond's experimental work on gas producers, which was started in 1879 and has been carried out on a large scale for a number of years at Winnington, Cheshire, England. This work resulted in the solution of the difficult problem of converting the cheap forms of fuel into a good gas of uniform quality in such a way that the ammonia existing in the fuel is not destroyed, but recovered as a by-product. Common bituminous slack, brought by railway wagons into the works, is mechanically handled by elevators and creepers and deposited in hoppers above the producers. From these, it is fed in charges of 8 to 10 cwts. at a time into the producer "bell," where the first heating of the slack takes place, and the products of distillation pass downward into the hot zone of fuel before joining the bulk of the gas leaving the producer. The hot zone destroys the tar and converts it into a fixed gas, and also prepares the slack for its descent into the body of the producer, where it is acted upon by an air blast, which has been saturated with steam at 85° C. (185° F.), and superheated before coming into contact with the fuel. Unlike what is done in other producers, the quantity of steam introduced into the blast is relatively large, and amounts to 2½ tons for every ton of fuel gasified. This large quantity of steam keeps down the working temperature of the producer within such limits as to prevent the formation of clinkers or the destruction of the ammonia, yet permits the fuel to be so thoroughly burned that good ashes are obtained. Half a ton of steam is decomposed in the producer for every ton of fuel burned, yielding thereby free hydrogen to the extent of 29 per cent by volume in the final gas. The hot gas and undecomposed steam leaving the producer pass first through a tubular regenerator in the opposite direction to the incoming blast. An exchange of heat takes place, and the blast is still further heated by passing down the annular space between the two shells of the producer on its way to the fire grate; then the hot products from the producer are further passed through a "washer," which is a large, rectangular, wrought-iron chamber with side lutes; and here they meet a water spray thrown up by revolving dashers, which have blades skimming up the surface of the water contained in the washer. The intimate contact thus secured causes the steam and gas to be cooled down to about 90° C. (194° F.), and by the formation of more steam, tending to saturate the gas with water vapor at this temperature, the bulk of the sensible heat is converted into latent; then passing upward through a lead-lined tower, filled with tile to present a large surface, the producer gas meets a downward flow of acid liquor, circulated by pumps, containing sulphate of ammonia with about 4 per cent excess of free sulphuric acid.

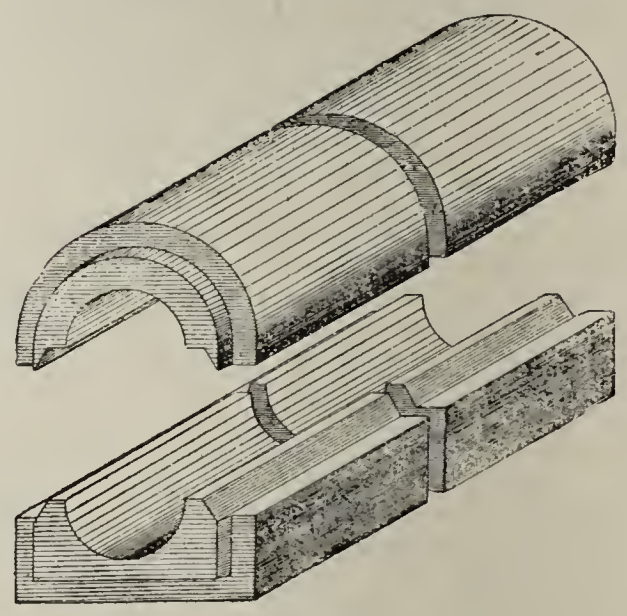
Combination of the ammonia of the gas with the free acid takes place, giving still more sulphate of ammonia, so that to make the process continuous, some sulphate liquor is constantly withdrawn from circulation and evaporated to yield solid sulphate of ammonia, and some free acid is constantly added to the liquor circulating through the tower. The gas, being now freed of its ammonia, is conducted into a gas-cooling tower, where it meets a downward flow of cold water, thus further cooling and cleaning it before it passes to the various furnaces and gas engines in which it is used. The cooling of the gas with its burden of steam results in the condensation of the steam and in raising the temperature of the cooling water, so that the latter leaves the bottom of the tower as hot water, which is utilized in a third tower, called the "air-heating tower," through which the air blast from the blower is directed. Here, the contact of hot water and cold air gives cold water and hot air, saturated with water vapor at 73° C. (163° F.). By this method of utilizing the heat of the gas from the producer, nearly 1 ton of steam is added to the producer blast for every ton of fuel gasified; and this cyclical exchange of heat is always going on, and forms one of the distinctive features in the economy of the process. The hot water from the gas-cooling tower is circulated through the air-heating tower, and being thereby cooled is again pumped up to the top of the gas-cooling tower. Both towers are filled with tiles, to give large surfaces of contact, and the circulating water acts as the heat-carrying agent between the hot gas and the cold air. The charging of the fresh fuel into the top of the producer and the withdrawing of ashes from the bottom in no way interfere with the continuous steady work of the producer. Also, the large volume of steam employed acts as a most perfect regulator in keeping the quality of the gas uniform. Each Mond producer of the ordinary size used at Winnington is capable of gasifying 20 to 24 tons of slack per day of twenty-four hours, and the volume of gas furnished from 1 ton of fuel fed into the producer varies from 140,000 to 160,000 cubic feet, according to the quality of the slack, and is sufficient to develop 2,000 indicated horsepower hours when utilized in a gas engine. The value of the sulphate of ammonia recovered from 1 ton of fuel is, at present prices, 8s. ($1.94), naked at the works.

* A paper read by Mr. H. A. Humphrey, M. I. Mech. E., at the Institute of Mechanical Engineers, London.

CONCRETE CONDUITS.

We illustrate a new system of concrete conduits construction, the invention of Pietro Melocco, of Budapest, Hungary. As will be seen in the illustration, the conduit is formed of sections consisting of a base, intermediate sections and cover. The intermediate layers can be built up tier after tier, until the required conduit capacity is obtained. When the several parts of a single section are assembled in place they form male and female interlocking joints. Each intermediate layer can be made to break joints with the preceding layer upon which it rests and thus form a ridged system of construction. The single conduit shown is designed for cable mains.



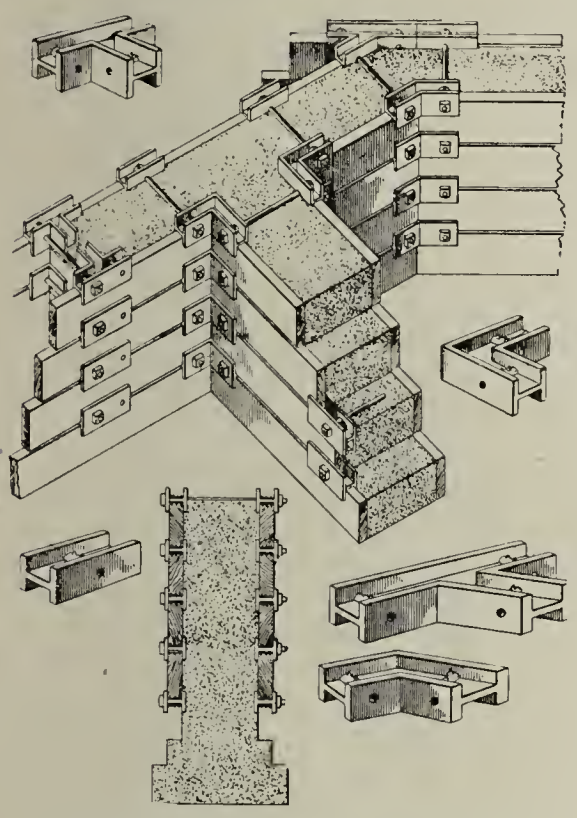


Muscogee Coal Co., W. L. Doane, president, Birmingham, Ala., desires communications from parties building machinery for Portland and hydraulic cement plants.

FARRELL'S PATENT BUILDING FORMS.

The Farrell Patent building forms are designed for use in the construction of monolithic concrete masonry of every kind. These forms can readily be erected by any person of ordinary intelligence. The depositing and tamping of the concrete being a simple operation, these forms can be used over and over again. We have had numerous inquiries for building forms for concrete masonry, from architects, engineers, contractors, farmers and bankers, showing that concrete construction is attracting more than ordinary attention at present.

As our illustration shows, the mold for the concrete wall is made of planks set on edge, the combined box cap and shoe-plank holder for these



BUILDER'S MOLD FOR WALL CONSTRUCTION.

planks comprising vertical sides connected by a horizontal web, giving the construction an H cross-section. The webs have small spurs which firmly engage the planks. The combined box-cap and shoe-plank holders are connected in transverse pairs by tie-bolts.

The combined box-cap and shoe-plank holders thus constructed may be given any desired form. The T-form is useful at the end of a wall; the straight form is employed to join together the meeting ends of two of the planks and also to strengthen the planks at points between their ends; the L-form is used when a rectangular branch of the wall is to be made; the obtuse-angled form is designed for use at the inside of a branch to or bend in the wall; and the Y-form is to be used at the outside angle of an obtuse bend.

In building up a wall, four or five courses of planks are placed on top of one another—sufficient to give the foundation its proper strength. The lower planks are then taken out and used again at the top of the wall, the concrete being filled in as before. The wall may therefore be built to any desired height without the use of a continuous sheathing.

The Farrell forms can likewise be used for the construction of curb wall and retaining walls, bridge approaches, abutments, bridge piers, coffer dam and dam moulds, and thereby dispensing with the usual intricate timber construction.

Full particulars relating to these forms can be obtained from the inventor, Thomas C. Farrell, Washington, N. J.

LIABILITY OF TRADE UNIONS.

London, Aug. 23.—Trades unionists are massing their forces for a determined campaign to secure the amendment of the laws for the purpose of reversing the recent Taff Vale decision. This is the most important labor judgment handed down in forty years. It renders trades unions liable to lawsuits and their funds open to legal attachment, on account of picketing or otherwise interfering with the employes of manufacturing concerns against whom a strike has been declared.

The labor organizations are drafting a bill by which they hope to attain their object. They will present the measure to every member of parliament, saying in effect: "Will you support this measure? If not, we are determined to prevent your reelection."

James MacDonald, secretary of the London trades council, in speaking of the endeavor to repeal the law, a few days since, said: "Four days after the issuance of the judgment the directors of the Bristol Tramway Company, whose employes were striking, placarded the city with posters offering a reward of £50 for identification and conviction of any picketer. It was the expectation of the company to prove that the offender was acting under instructions of the union and then sue the organization, attach the funds and in this manner break the backbone of the strike.

"Added to the fear of legal oppression British workmen are confronted with the prospect of hard times industrially," continued Mr. MacDonald. "While outwardly the country is prosperous, the number of unemployed in many trades is unusually large and is certain to be increased greatly in a short time."

A new company has been organized at Battle Creek, Mich., with a capital of $250,000 for the manufacture of cement posts for fences, etc.

A NEW CEMENT MILL.

The Vulcan Portland Cement Company is now erecting at Vulcanite, Warren County, N. J., a new mill to have a capacity of 2,000 barrels per day. This mill, when completed, will be up to date in every particular, being equipped with the most improved labor-saving appliances and economical machinery. The full capacity of the Vulcanite works will then be 4,000 barrels daily. This new mill will be completed and in operation about the first of the year 1902. The demand for "Vulcanite" is on the increase, and up to this date it has required the full capacity of its present mills to fill the orders.

There have been various reports, printed and otherwise, connecting the Vulcanite Portland Cement Company with the intention of erecting a plant in Missouri, or elsewhere in the west. We are authorized to deny any connection on the part of the Vulcanite Company with any western project relating to the manufacture of cement.

L. S. Russell of the Michigan state bureau of labor and industrial statistics, spent several days in Coldwater last week investigating the working of the Michigan Portland Cement Co.'s plant. His work will cover all the plants in the state, of which there are now thirteen completed and several in process of construction and no end to the number contemplated. The largest cement factory in the state is under erection at Baldwin; it has a capacity of 4,000 barrels a day. Perhaps the smallest is at Jonesville, which employs only 75 men, but is after all the model plant of the state.

The Art Stone Company, of Columbus, O., John A. McDowell, manager, has taken up the work of building cement houses, cement steel arch bridges and floors and other concrete stone work. They have secured the H. S. Palmer patent process and machine for making hollow building blocks in this market and are doing a good business. They have just closed the contract for furnishing all the outside stone work in the new row of flats to be built on Hubbard avenue and Park streets by Mr. Charles Schenck, owner and Mr. R. Z. Dawson, architect. Upon the completion of the work for this building they will go to Newark to get out the material for a $20,000 residence to be built by Attorney Fitzgibbon of that city. The stone will be covered with green material, which has been imported from Germany, and will be much richer in appearance than any natural green stone, with only two-thirds the cost.

NEW GERMAN RULES FOR THE STABILITY OF CHIMNEYS.

Some time ago the Prussian Minister of Commerce and Industry requested the Boiler Insurance Societies and allied organizations to investigate the principles underlying the construction and dimensions of chimneys. The societies mentioned, the Society of German Engineers, the International Union of Boiler Insurance Societies and a number of specialists were represented on the commission which undertook this work. Mr. Th. Peters, director of the Society of German Engineers, was chosen as the manager of the investigation, and, in a recent issue of the "Zeitschrift" of the society, he has published a report of its conclusions, of which a brief abstract follows:

Section I.—The proposed rules refer only to chimneys of the dimensions employed in the greater number of cases, that is, up to 75 (243 ft. 9 in.) meters height and 3 (9 ft. 9 in.) meters clear width at the top.

For chimneys of greater dimensions than these, there is a lack of satisfactory precedent for the establishment of standards, and the rules for average dimensions would not apply to extraordinary cases. The Commission was of the belief, however, that there is no need of directions for unusual cases.

Section II.—As a rule, 150 kilograms per square meter is to be taken as the wind pressure on a plane surface at right angles to the direction of the wind. Any chance suction on the lee side is included in this amount. Any shielding of the chimney by neighboring or surrounding buildings is to be neglected. The center of presure of the wind acting on the stack is assumed to be at the center of gravity of the vertical cross-section. If F represents the area of such a section, taken normal to opposite surfaces in the case of angular chimneys, the amount of the wind pressure is 0.67×150 F for round chimneys, 0.71×150 F for octagonal, and 150 F for square.

These values also hold when the wind blows toward an angle. This latter direction determines the maximum pressures at edges in the case of angular chimneys.

According to articles in technical literature, a pressure exceeding 144 kilograms per square meter has been occasionally observed in Germany, Austria and Belgium. The Commission accordingly chose 150 kilograms, which is the amount prescribed in Austria also. The pressure of 125 kilograms, proposed by others is too low, at least for high chimneys, because it is probable that the pressure increases with the height above the ground level. A single value is highly desirable, however, for all heights up to 75 meters. On the other hand, it may be advisable for very high chimneys in particularly unfavorable situations, along the coast or on mountains, to go as high as 200 kilograms.

The Commission recognized clearly how unsatisfactory is the present knowledge of wind pressure, and how much the preceding rules need confirmation. It therefore concluded to recommend very urgently a comprehensive experimental investigation of the subject. In making the choice, however, between entirely abandoning their work or using the existing deficient material as a starting point, the Commission believed the latter course preferable.

Section III.—A computation of the weight must precede the calculation of the stability.

A computation of the weight is necessary because the stability and the stresses depend on it. The following rules are suggested for lightening the work:

The weight of a round chimney can be figured by multiplying the weight of a cubic unit of the masonry by the contents of the separate drums or shells, each figured by the formula, $C = 0.7854z\ (D^2 - d^2)$. In this expression D and d are the mean inner and outer diameters, z the height of the shell; the thickness of the shell is assumed to be uniform. The weight and surface of architectual additions, caps, cornices and the like, are to be neglected.

Section IV.—The contractor for the chimney must accept entire responsiblity for the correspondence of the unit weight of masonry assumed in the computations with that of the materials actually employed, as well as for their fulfillment of the specifications for quality and strength. It is left to the party letting the contract to demand proof of the correctness of the unit weight established and of the other specifications enumerated in Section VI., or even to exercise a control over them.

It is impracticable in computations of stability to determine all factors which have a strong influence with such certainty that a subsequent calculation of the correspondence of the actual materials and strains with the assumption may be omitted. On this account, because of the great influence of the weight on the stability and the widely different specific weights of the materials of chimney construction, the Commission did not propose a definite unit weight for masonry.

Section V.—In determining the stability of chimneys, which may be regarded as single masonry-masses on which the wind pressure is the sole overturning force, proof must be had, in the interest of safety, that the resultant of the weight above the most dangerous horizontal section and the wind pressure from the most unfavorable quarter lies within the masonry and far enough away from the outer edge to prevent any injury to the material on account of the pressure. This must be true without making any allowance for the adhesion of mortar, and assuming that the joints on the windward side can open without hindrance.

There is no doubt that masonry can resist tension if made with care from good materials, particularly after the mortar has had time enough to harden. But the greater or smaller degree of fulfillment of all such assumptions and the impossibility of providing in advance for such highly important influences on stability as rapid construction, the weather and the like, led to the conclusion that the tensile resistance of masonry should not be taken into account.

Section VI.—The pressure on the most heavily loaded edge must not exceed $(5 \times 0.15\ H)$ kilograms per square centimeter. In this expression H is the distance in meters of the joint from the top of the chimney. If the value thus determined exceeds 12 kilograms per square centimeter, using cement-lime mortar, proof of the strength of the stone and mortar may be called for. By cement-lime mortar is meant one containing at least one part of Portland cement to two parts of fat lime and six to eight of clean, sharp sand. If fat lime mortar is used, a pressure of 7 kilograms per square centimeter must not be exceeded.

The joints on the windward side must not open more than half their width. This condition is reached when A is less than $\frac{1}{2}R + \frac{1}{4}r$, where A is the distance from the center of gravity of the section to the point of application of the resultant of the weight and wind pressure, and R and r are the radii of circles bounding the outer and inner perimeters of the section.

The longer time spent in the construction of high chimneys, their greater area, and the better grade of materials generally employed in their construction warrant higher permissible stresses in their lower portions than is the case with chimneys of less height. A measure for this is furnished by the above entirely empirical expression. The difficulty introduced in the design by this variable permissible stress is not so great as to offset the resulting economy. In determining the permissable stress the

Commission found itself in the same situation as in determining the wind pressure, and it was considered better to make use of the incomplete existing information concerning the strength of masonry than to abandon the investigation.

As a rule the Commission held that the materials in a chimney should not be strained to more than one-tenth their ultimate resistance. It may be assumed that the preceding rules conform to this principle, at least with joints under 15 millimeters thickness. Materials of considerable greater strength are often used, and it would be unjust and unsuitable not to permit them to be strained to one-tenth their ultimate strength. But in such cases proof must be forthcoming when desired that this greater strength is actually attained during the time the chimney is under construction.

The second requirement, that A is less than $\frac{1}{2}R+\frac{1}{4}r$, calls for larger dimensions in small stacks than the first requirement. Its neglect in such low stacks would lead to an opening of the joints far beyond their middle, which might cause highly hazardous swinging, eccentric pressures, shearing and even overturning. A numerical example will illustrate this:

With an upper clear diameter of 0.6 meter and a shaft 16 meters high, the first requirement permits a maximum unit pressure of 7.4 kilograms. With a unit weight of 1,650 kilograms per cubic meter and 150 kilograms wind pressure, the following dimensions are obtained: Thickness of top shell, 0.15 meter; offset of each of the five drums or shells, 0.05 meter; height of shell, 3.2 meters; inner diameter at the bottom, 1.1 meters; outer diameter at the bottom, 1.8 meters. Thus A is equal to 0.645 meter, although the second requirement permits only 0.5875 meter. The joints would open 1.1111 meters therefore, on the windward side, 23 per cent. more than half their width, which is highly serious.

An increase in section is imperative and may be given in various ways. By using a stone of 1,750 kilograms weight and increasing the batter of the chimney to 6 centimeters in the meter, the dimensions become: Outer base diameter, 1.86 meters; inner base diameter, 1.16 meters; A, 0 602 meter, just under the amount allowed. The maximum unit pressure will be 5.71 kilograms, and the opening of the joint on the windward side will be 0.819 meter, less than its half. In case the permissible limit of A is but slightly exceeded and the most dangerous section is surely in the base, the most simple remedy is to add a small plinth to the latter.

Section VII.—In the upper offset joints the maximum stresses given in Section VI. must likewise not be exceeded. In case the shells have equal heights the test is to figure the pressure for each of the offset joints, from the base upward, until they show a decrease in the unit stress. With drums of unequal height, the pressure is to be figured at each offset section.

As a rule this requirement is answered by a few computations. The provision of Section VI. suffices to assure a gradually decreasing stress from the bottom upward. There is no objection to this because the safety of the entire structure is made dependent on the most strained joint.

Section VIII.—The maximum edge pressure which the chimney while subjected to wind pressure exerts on the earth must not exceed 2.5 kilograms per square centimeter. At the same time the base must never rise from the earth at the windward side.

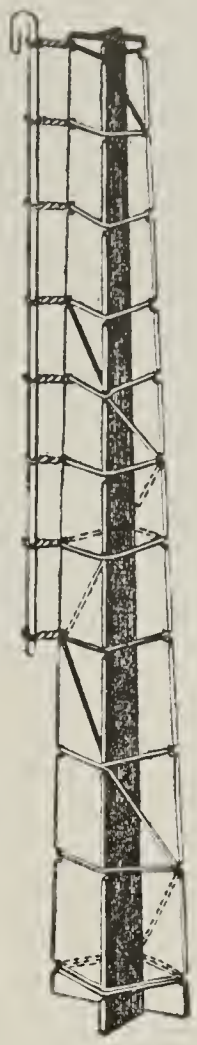
In reaching this conclusion, the Commission again had to overcome many difficulties. The character of the earth, its dampness, the depth of the foundation and numerous other circumstances presented a host of variations. It was also noticed that nearly everywhere there were already regulations concerning the allowable loading of earth. Hence many of the members were opposed to the fixing of the 2.5 kilogram limit, and the section was finally adopted by a majority of a single vote. The other sections were approved unanimously or practically so.

The Commission thoroughly discussed the matter of proposing a single, carefully elaborated method of computing the stability, and decided not to do so. After it was determined not to allow tensile strength to be considered, those methods of calculation were necessarily excluded which figure the stack merely as an upright subject to pressure and bending. For the computation of round chimneys the Commission recognized the simplicity and safety of the tables of Professor Keck, of the Hanover Technical Institute, and the methods of Professor Lang, of the same school. But it was finally deemed best to permit any correct method.—*Engineering Record.*

Topham Richardson, chairman, and J. L. Spoor of the board of directors of the Portland Cement Co. of Utah, are in Salt Lake City from London, Eng., looking over the plant in that city, which passed into the control of English capitalists last May. They express themselves as well satisfied with the management and condition of the plant and pleased with the general business outlook.

CEMENT FENCE POSTS.

The Michigan Cement Post Co. of Marshall, Mich., will manufacture cement posts after the invention of John F. Martin. We illustrate a skeleton wire frame, being the metal portion of the post which will be encased in Portland cement mortar. The factory will be located on Kalamazoo avenue, Marshall, Mich. The cement post business promises to become a large industry and will eventually displace the cedar post now in common use inasmuch as the cedar post is liable to be destroyed by fire while the cement post is fireproof. A single railway corporation in the West purchased 500,000 cedar posts in 1900 for fencing in its right of way. The cement post can be sold for a slight advance over the cost of the cedar post. There are several cement fence post factories in Michigan sustained by strong financial backing.



STEVENS' LITHOLITE STONE.

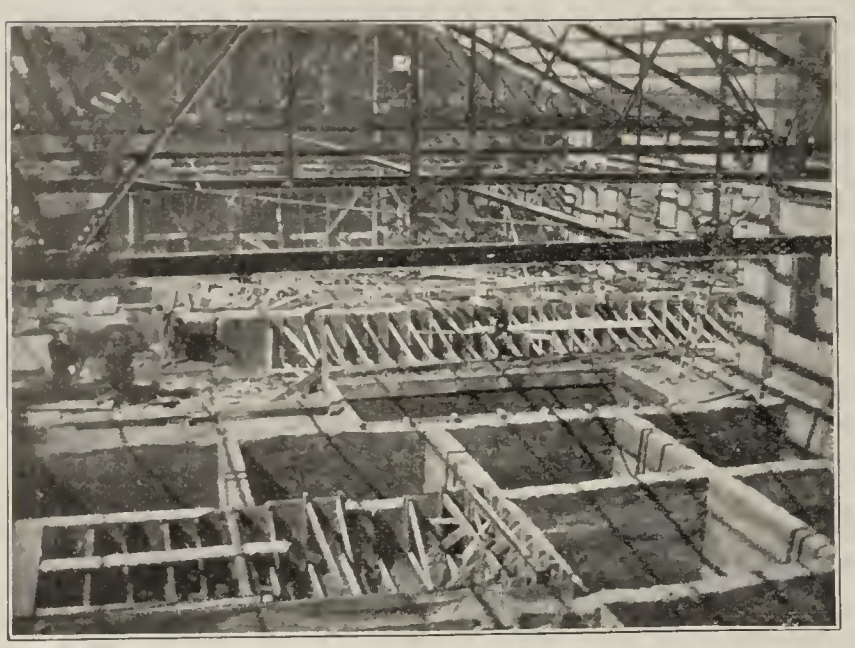
C. W. Stevens has just returned to Chicago from New York, where he closed a contract with Messrs. Grant & Hale to furnish his patent litholite stone in a fourteen story building located on the corner of Beekman and Nassau streets, having a frontage of 156 feet on the two streets. The first two stories will be finished entirely in Stevens' litholite (Portland cement) stone. The stone for this work will be manufactured in Jersey City.

Mr. Stevens has likewise closed for additional territory with Messrs Lake & Atlee of Washington, D. C., who have been operating a small litholite stone factory under the Stevens patents issued in 1899. This firm has now purchased the State of Maryland and will operate under the old and new Stevens' patents under a stock company with $60,000 capital. A branch Litholite stone factory will be erected at Baltimore, Md. The work Messrs. Lake & Atlee have turned out in the District of Columbia has been the first and given entire satisfaction.

Incorporated: Big Four Plaster Company, Oakfield, Genessee county; to mine gypsum and to manufacture all kinds of plaster; capital $10,000.

DETROIT PORTLAND CEMENT COMPANY, FENTON, MICHIGAN.

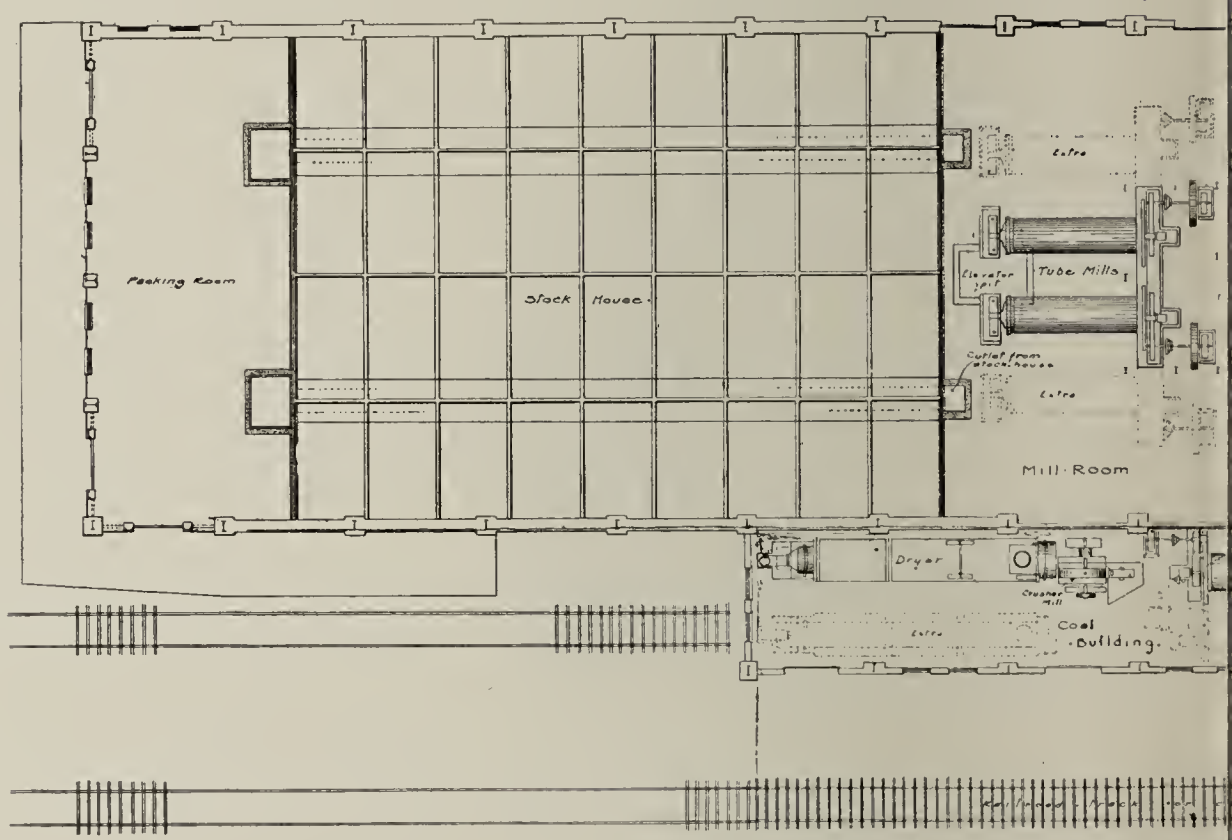
The plant of this company, located at Fenton, Michigan, is now nearing completion. The mill is designed to manufacture Portland cement from a mixture of marl and clay by the wet process, and possesses some distinctive features not embodied in the marl plants heretofore erected.



SLURRY ROOM (looking west.)

THE MILL UNDER CONSTRUCTION.

The buildings, substantianlly costructed of brick and steel, are fire proof, and so designed that the material in progress of manufacture will move in one direction from the time the raw materials are brought in at one end until the cement is shipped out from the packing house at the farther end. All the buildings have clear spans. The mill is located on a slight elevation overlooking the large marl deposits of Mud and Silver Lakes owned by the company. The clay is obtained from pits a few miles distant from the plant. The marl is dredged from the lakes and carried by belt conveyors from the wharf to the raw material building, special unloading machinery having been devised for emptying the boats. The clay is brought into the plant by rail. The two ingredients after passing through separate preliminary preparation are mixed together in the proper proportions and ground in tube mills. Large concrete storage pits contain the marl and clay before mixing, and similar pits are provided for the mix and ground slurry. It has heretofore been the practice to pass the clay through some suitable dryer, then after it has been ground to an impalpable powder, to mix this powdered clay with the marl. In this plant, however, the clay is unloaded directly from the cars into a disintegrator, from which it discharges into a pugging conveyor which carries it to a wash mill where it is reduced to a thin sludge. The marl passes first, through a stone separator which reduces it to a smooth plastic state and removes any roots, grass or stones which may have been brought up by the dredge bucket. It is then stored in the marl pits. Each pit is provided with an agitator to prevent settling. The marl and clay are pumped to the mixing pits in proper proportions and thoroughly agitated. From these pits the raw mix is pumped to iron tanks above the tube mills from which it is fed to the mills by gravity. After being ground in the tube mills, the slurry is discharged into concrete storage pits which supply the kilns, the slurry being pumped to a stand-pipe from which it is fed at a constant pressure directly into the kilns. After passing through the kilns, of which there are eight, the clinker falls into air-tight, self-emptying concrete cooling vaults, located below the kiln room floor and directly under the discharge from the kilns, two vaults being provided for each kiln; the Lathbury & Spackman patent cooling and regenerative system being used. Cold air is drawn in through openings in the bottom of these vaults, and passing upward through the clinker cools it. The hot air being exhausted from the top is forced into the kilns mixed with pulverized coal, thus utilizing the heat contained in the clinker for burning. The clinker is drawn out at the bottom of the vaults into cars which run on tracks located in the tunnel below the clinker cooling vaults. These cars are run out of the tunnels and raised by an electrical lift to the level of the top of the bins feeding the clinker ball mills, and the clinker is discharged from the cars into these bins. After passing through the ball mills, the partially ground clinker is elevated and conveyed to the bins supplying the tube mills. From these mills, it is

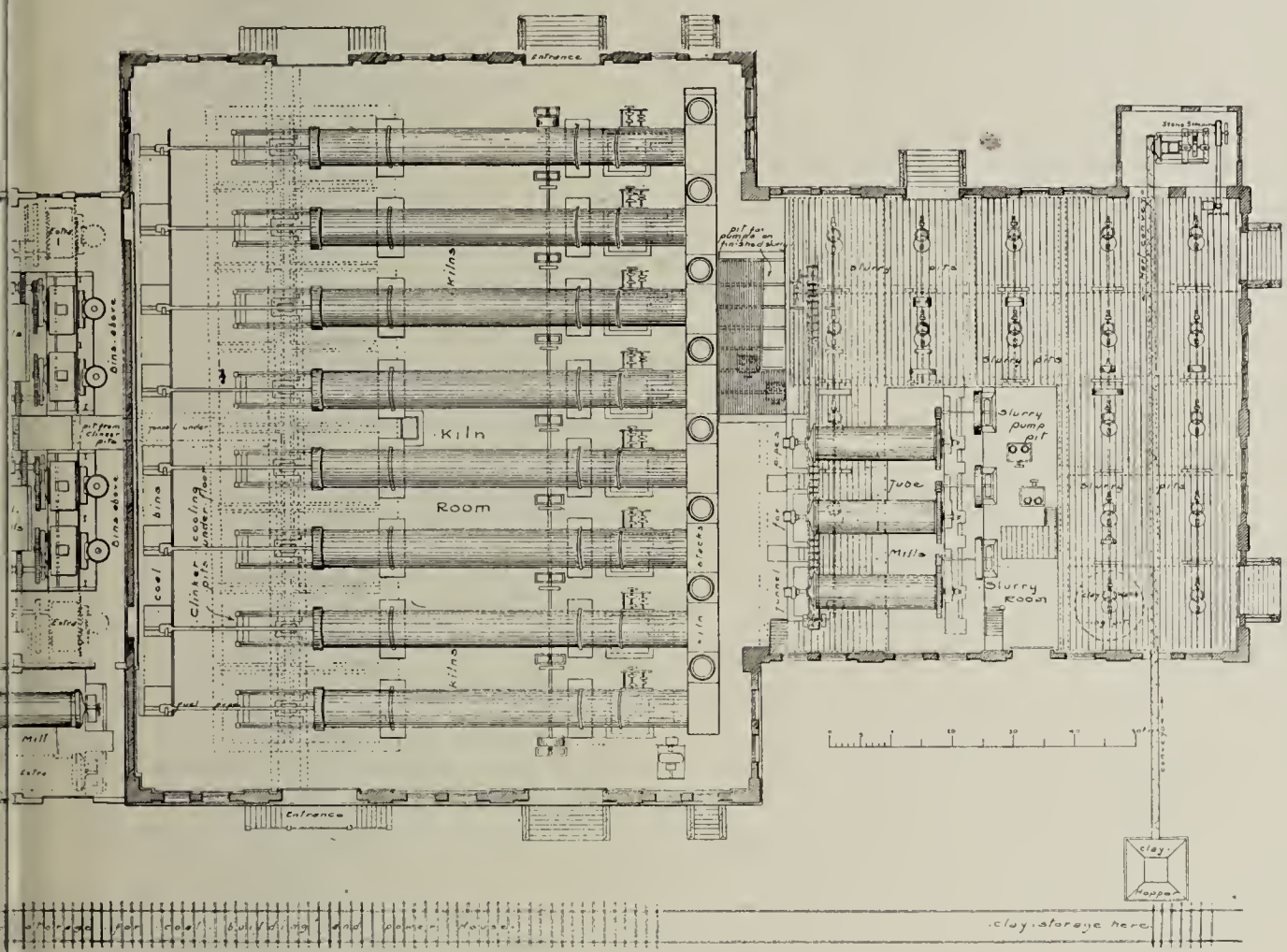


FLOOR PLANS AND MACHINERY INSTALLATION D

elevated and conveyed to the stock house and distributed in the bins. The stockhouse is equipped with Lathbury & Spackman self-discharging bins. Conveyors in the tunnels of the stockhouse carry the cement to the packing room, located at the extreme end of the building, and deliver it to the bins over the packing machine. The packing department, fully equipped with both barrel and bag packing machinery, has a capacity of fifteen hundred barrels of cement per day.

The power house, located close to the main building, is equipped with four 200-horse power vertical water tube boilers. Two 400-horse power compound condensing engines direct connected to two 300 K. W. direct current generators are located in the engine room. An auxiliary 150 K. W. direct connected dynamo and engine is provided to furnish current for lighting and power when the plant is operating under light loads. The power plant is completely equipped with the usual accessories such as switch-board, pumps, condensers, etc., and special attention has been paid to securing economy in the generating of power. The entire plant is electrically driven, the motors being distributed throughout the plant, each machine being belted direct to its own motor.

The Federal Asphalt Co. with a capital of $5,000,000, has just been formed for the purpose, it is said, of becoming a competitor of the Barber Asphalt Co. Asphalt will be obtained in Kentucky. M. D. Coffeen is manager of the new firm.



ROIT PORTLAND CEMENT COMPANY'S WORKS, FENTON, MICH.

AMERICAN CEMENT MACHINERY.

London, Aug. 7.—Five of the most prominent manufacturers of England, who recently visited the United States, have returned strong in the belief that only the prompt introduction of the American machinery process can enable Great Britian to retain its present hold of the cement business. William Harper, manager of the Commercial Intelligence bureau, said:

"The Americans a short time ago adopted a secret process of manufacturing cement by means of rotary roasting mills, which will drive England, France, and Germany practically out of the field. By the aid of simpler and cheaper machinery the Yankees are able to make their article in eight hours, while England, with its ancient, cumbersome equipment, requires three or four weeks. The cost of the American product is less than half that of the English.

"Lancashire and Kent experts went to America, where they carefully examined the new process. They are now planning the erection in England of mills fitted after the Yankee pattern. The British cement industry is of considerable magnitude and represents large capital and remunerative returns. The cement mills which America is building everywhere will speedily produce sufficient for the home trade. Then the manufacturers will turn their attention to the export business, and will land their article here at prices defying competition. The Britishers are apparently aware of the fact and do not intend to relinquish their immense home and foreign trade without a struggle."

P. E. Taintor of Springfield, Ill., has the contract for erecting a large concrete dam to be built in the Illinois river about three miles below Havana, Ill.

CONCRETE STORAGE PITS.

SLURRY ROOM (looking east.)

NATURAL GAS IN KANSAS.

W. L. A. Johnson, secretary of the Kansas State Society of Labor and Industry, has prepared a chapter for his next annual report on the subject of the "Development of the Kansas Gas Belt." It is as follows:

"Among the natural resources of Kansas the wealth produced by the gas belt is greatly in excess of that produced by any other industry. The oil and gas fields of the state cover about 350 square miles and comprise the counties of Allen, Linn, Bourbon, Neosho, Wilson, Elk, Montgomery and Chautauqua. More than 100 wells have been drilled in this district, the average depth of which is 900 feet. The average output of a well ranges from 2,000,000 to 12,000,000 cubic feet of gas every twenty-four hours.

"The great value of natural gas as a fuel in manufacturing has become a matter of much concern to our coal producing counties. A comparison of the heat unit in the two articles of fuel shows that 2,000 cubic feet of gas equal in heat one ton of bituminous coal. It is estimated that 100 or more manufacturing concerns in Allen county are using gas for fuel. Chemical analysis of the Kansas gas shows it to be far superior to the gas found in eastern states.

"The six smelters in the district which have reported to this office employed 1,123 men during 1899 and 1,888 in 1900. The value of the raw material produced by these plants in 1899 was $68,290, and for 1900 it amounted to $154,200. The value of the manufactured product for 1899 amounted to $2,879,352, and for 1900 to $3,411,712.

"The value of the manufactured products of the brick plants of the district for 1899 amounted to $109,000, and for 1900 to $153,000.

The Iola Portland Cement Company uses gas for fuel.

GRIFFIN MILL SALES.

The Associated Portland Cement Manufacturers, Limited, the English cement trust, have adopted the Griffin mill, and have sent the initial order for sixteen. The twenty-four Griffins in the works of Martin Earle & Co. L't'd. by their satisfactory work settled the matter.

The Great Northern Portland Cement Co. of Baldwin, Mich., will use forty-eight Griffin mills. Work on this immense plant is progressing rapidly and part of the machinery is in place.

The Lehigh Portland Cement Co. has closed a contract for Griffin mills for its new plant now under construction.

BOOK NOTICES.

We are in receipt of a test sheet from the Chickamauga Cement Co., manufacturers of hydraulic rock and Portland cement, Rossville, Ga., showing tests of the Dixie rock cement on 10 briquettes. Neat cement lowest broke at 87 pounds, 24 hours; highest at 94 pounds, with an average of 91 pounds. 7 days, lowest 177 pounds, highest 186 pounds, average for 10 briquettes 183 pounds. The set began in 28 minutes; time of set 3 hours and 38 minutes.

"Geological Survey of N. J." Annual report of the state geologist for 1900, Henry B. Kummel, assistant state geologist in charge. Part II contains a report on the Portland cement industry, covering ninety-two pages, with numerous maps showing the locations of cement rock deposits in the state, with cross-sections of the various formations. The report is replete with valuable data on the Portland cement industry of New Jersey, as well as general information on the subject which will be appreciated by all engaged in the manufacture of Portland cement. We congratulate Mr. Kummel on the thorough manner in which he has treated the subject.

"Industrial Opportunities." Under the above title the Lackawanna Railroad has issued for circulation a book giving detailed information covering raw materials, shipping facilities, cost of labor, sources and prices of power, value of lands suitable for manufacturing plants and special inducements existing along the lines of the road. This book can be had upon application to Wm. B. Hunter, industrial agent, Lackawanna Ry., 26 Exchange Place, New York City.

REMOVAL NOTICE.

The general sales offices of the Iola Portland Cement Co. will on and after September 14th be removed from Chicago to St. Louis, Mo., where they will occupy suite 928 Lincoln Trust building, Seventh and Chestnut streets.

The superior advantages of concrete as a fire-resisting material were well illustrated in a recent fire at the Crescent Cement Works at Longue Point, Canada. The walls of the buildings were constructed entirely of concrete, and these were found to be practically intact after the fire, which was so severe as to completely wipe out the plant otherwise. Brick or masonry, it is asserted, under the same circumstances, would have been seriously injured.

CONCRETE PAVEMENTS IN NEW ORLEANS.

Canal street, New Orleans, La., is about 135 feet wide between the sidewalks. On each side of the pavement there is a roadway 37 feet wide, on which is all the traffic. In the center of the street there is a section 60 feet wide, which has been known as "neutral ground," on which the local street railways have laid their tracks. Recently an effort has been made to improve the condition of the street, and after considerable study it was determined to pave this central section with concrete. Accordingly a regular concrete pavement, such as that used in sidewalks was laid down, the bottom of which extends to the depth of the ties upon which the rails are laid. Instead of being a solid mass, it is laid down in blocks with sand joints. Eight-inch sand joints are provided between the paving and the rails to prevent spreading of fractures which may develop after a time. This also permits the ready repairing of the rails, or renewing of bonding without great expense. The experiment of using a concrete surfaceway in streets will be watched with much interest by municipal engineers.

RAILWAY EMPLOYES IN THE UNITED STATES.

The number of persons employed by the railways of the United States, as reported for June 30, 1900, was 1,017,653, or an average of 529 employees per 100 miles of line. As compared with the number employed on June 30, 1899, there was an increase of 88,729, or 34 per 100 miles of line. From the classification of these employees it appears that 42,837 were enginemen, 44,130 firemen, 29,957 conductors and 74,274 other trainmen. There were 50,789 switchmen, flagmen and watchmen.

Disregarding 8,394 employees not assigned to the four general divisions of employment, it is found that the services of 36,451 employees were required for general administration; 324,946 for maintenance of way and structures; 197,799 for maintenance of equipment and 450,063 for conducting transportation.

During the year ending June 30, 1900, $577,264,841 were paid in wages and salaries, an amount $131,756,580 in excess of that paid during the fiscal year 1895. The compensation of the employees of railways for the fiscal year 1900 represents 60 per cent of the operating expenses of the roads and 39 per cent of their gross earnings.

The Newaygo Portland Cement Co. is manufacturing the "Gibraltar Brand" of Portland cement.

A Catholic church at Big Rapids, Mich., is being built of Portland cement.

Hamilton, Ontario, will lay 15 miles of cement walk during the present season.

The Iowa Central Ry. Co. is improving its right of way by putting in concrete culverts and small concrete arches.

The new Roman Catholic cathedral in London, Eng., to cost over $5,000,000, will be built entirely of Portland cement.

The price of combined cement curb and gutter is 80 cents per lineal foot in Denver, Col.

The Kankakee Electric Co. of Kankakee, Ill., is considering the building of a concrete dam.

20,000 acres of asphalt lands have been located on Promontory by Ogden, Utah, men. Samples tested show 85 per cent asphaltum.

Contracts will be let in a few days for the plant of the Hecla Cement Co. at West Bay City. About $100,000 will be spent in improvements.

Bids are requested for the construction of cement walks at Batavia, Ill. Bids will be opened October 7th. Address Geo. H. Burnett, City Clerk.

The American Tomb Co. has been organized to manufacture the Reeves concrete tomb for burial purposes. The company has works at McKeesport, Pa.

Incorporated: The Mohawk Cement Company, capital stock, $350,000; object, manufacturing; principal office, 1 Montgomery street, Jersey City, N. J.

Incorporated: Steel Band Concrete Co. at Pierre, with a capital of $500,000. Incorporators: Hammond A. Meurier, Ernest Rennacker and W. A. J. Seals, all of Omaha, Neb.

The Acme Cement and Plaster Company of East St. Louis filed a certificate in the County Recorder's office Monday showing an increase of its capital stock from $800,000 to $1,000,000.

The Rock Island Ry. bridge gang commenced work on August 5th on the concrete work for widening the bridges and culverts between Muscatine and Davenport, Iowa, preparatory to double-tracking the road.

Mr. George Miner, who for a number of years has been in the employ of the Cummings Cement Co., has gone to Rossville, Ga., near Chattanooga, Tenn., where he will supervise the machinery in the mill of the Chickamauga Cement Co.

The Parker-Washington Asphalt Co.'s plant of Kansas City was destroyed by fire August 10th. The loss to the building and contents was $5,500. The machinery was badly damaged. The loss was fully covered by insurance.

The White Cliff Cement Works were sold at Richmond, Little River County, Ark., by Master in Chancery C. B. Moore, of Little Rock, for $160,000 to Mr. Heinecke, representing the Guardain Trust Company, holders of the second mortgage bonds.

Frederick L. Eldridge and L. Heynecker will act as a committee to reorganize the affairs of the White Cliffs Portland Cement & Chalk Co. and copies of a security holders' agreement and a plan of reorganization may be obtained from the Knickerbocker Trust Co. of New York City.

The Coldwater correspondent of the Detroit *Journal* quotes Secretary Root as saying that the reorganization of the Michigan Portland Cement Co. will not be completed before Jan. 1. The plant here employs 200 men and is turning out 8 or 10 cars of cement every day.

The International Cement Co., which was recently incorporated, has purchased 10 acres of ground at Aliquippa, Beaver county, Pa., for $19,000, through W. A. Herron & Sons. A $150,000 plant for the manufacture of cement from furnace slag, and having a capacity of 400 tons daily, will be erected.

Many Portland cement propositions are projected for Michigan, but the various syndicates find it hard sledding to finance them. Stocks and bonds have been freely sold in the past, but now tired holders never seem able to quote a price low enough to induce any person to repurchase a dollar's worth.

S. G. Nelson, the Chicago landscape architect has been employed to prepare plans for the improvement of Union Park, Des Moines, Iowa, and the river front. At present he is engaged on the river front plans, where a cement wall five feet in height will separate the sloping terraces from the water along the entire water front.

The Illinois Steel Company is about to begin the construction of a cement storage elevator at its works in South Chicago. It will be of the Monier type of construction, and the contract has been let to E. Lee Heidenreich. The elevator will comprise five tanks, each 25 feet in diameter and 50 feet high. These will have a capacity of 25,000 barrels and will cost $15,000.

Articles have been filed by A. T. Lien and J. J. Long of Mason City for the Mason City Lime & Cement Co. with $10,000 capital.

La Porte, Ind., has just awarded contracts for cement walks to the amount of $20,000, besides ten miles of brick street pavements.

The German Portland Cement Company of White Pigeon has closed negotiations for the purchase of the Kidd millpond property. A dam will be constructed and water power used to generate electrical power to operate its plant.

The Union Akron Cement Co. of Akron, N. Y., has leased an abandoned cement rock mine to parties who will cultivate mushrooms. The depth of the mine maintains an even temperature of about 50 degrees and is therefore specially adapted for the cultivation of mushrooms. The product being largely shipped to New York markets.

Washington Litholite Co., Washington, D. C., has been organized, with capital stock of $60,000, for manufacturing litholite building stone, made by combining natural stone and cement. Albert Lake operates a small plant at Twelfth and U streets N. W., which will be absorbed by the new company.—*Baltimore Mfg. Record.*

Beaumont, Texas.—Asphelt and Refining Company. Chartered: Central Asphelt & Refining Co., capital siock $2,000,000, by Charles A. Towne of Duluth, Minn.; Martin Howard of Chicago, Ill.; Stephen M. Scott of Emporia, Kans.; John P. Withers of Beaumont and others. This company will erect concrete storage tanks at Beaumont and Port Arthur, Texas.

The Federal Asphalt Co., which has been capitalized at $5,000,000, has just been incorporated for the purpose of competing with the Barber Asphalt Co., which has enjoyed almost a practical monopoly. Several prominent capitalists are behind the scheme, among whom is Gilbert B. Shaw, vice-president of the American Trust & Savings bank of Chicago, who has been elected a director in the organization. The company proposes to use rock asphalt entirely and large mines of the material have already been secured in Kentucky. It is understood that the Federal Co. will institute a working combination with the North American Paving Co. and these organizations will at once begin the fight for a portion of the business which would otherwise go to the Barber people. A general rate war between the two opposing interests is expected in the near future.

Alderman Strode of Kansas City, Mo., appeared before the board of health and protested on behalf of several citizens of the fifth ward against the rebuilding of the Parker-Washington asphalt plant at the corner of Twenty-third street and Pennsylvania avenue, which was recently destroyed by fire. The property-owners declare that the plant is a nuisance, located as it is in a residence district.

The Hercules Cement Co., whose plant is along the Lehigh Valley Railroad, between Coplay and Cementon, made an assignment August 13th, for the benefit of creditors to George H. Williams of Catasauqua. The plant is one of the oldest in the Lehigh region, and has a capacity of nearly 600 barrels a day. It is stated the inability of the concern to compete with the larger manufacturers caused its financial difficulties.

The Texas Portland Cement and Lime Co., of Dallas, Texas, would like to correspond with a bright energetic man, capable of handling as superintendent, a 600 bbl. cement plant. He must be thoroughly reliable and capable of handling with rapidity any and all breaks which occur daily in cement mills and cause delays. Good salary to the right man. None but parties capable of handling men and machinery as above stated need apply. Texas Portland Cement & Lime Co., James F. Taylor, General Manager.

L. C. Voglesang of Wellston, Ohio, will build a new Portland cement mill at Bartles Station in Lawrence county, Ohio, 10 miles north of Ironton. It will be located on the Ironton branch of the Cincinnati, Hamilton & Dayton railroad. The new plant will have a capacity of 1,000 barrels a day. Coal, limestone and clay are found on the lands and these will be used in the manufacture of cement. With Mr. Voglesang are associated several wealthy Ironton men who have abundant capital to further the enterprise.

The operation of cement works situated in a manufacturing district does not constitute a nuisance, holds the New York Supreme Court, appellate division, in the case of Roscoe Lumber Co. v. Standard Silica Cement Co. (70 N. Y. Supp., 1130); and an injunction will not lie to restrain the operation of the works where it is shown that the only injury complained of is the dust from the plant. The court said that if the rule sought to be applied in this case were once established the result would be practically to close every factory in the state.

The Decarbonated Lime and Stone Company, of Daynesboro, Pa., yesterday paid out its first dividend, one of five per cent on the capital stock of $12,500. The dividend is an excellent commentary on the efficient manner in which the affairs of the company have been conducted.

A mining exposition will be opened at the Grand Central Palace, New York City, on December 2d and continue fifteen days. The exposition will contain exhibits from miner's cradle and pan to power drills and electrical, chemical and mechanical processes for the extraction of metals from ores. The advance made in methods by mining men will be demonstrated and illustrated. A historical feature of the exposition will be an extensive reproduction of a frontier mining camp, with genuine hand made tools, utensils, apparatus, structures and furniture used by the miners in placer mining and development work in quartz mining. Address Allen S. Williams, Park Row Building, New York.

The White Cliffs Lime & Portland Cement Co.'s works, grounds, machinery, etc., situated at White Cliffs, Ark., twenty-five miles north of Texarkana were sold August 5th, under an order of the Federal Court, the purchasers being Eastern capitalists and the price paid being $160,000. The sale took place at Richmond, Ark., in the county where the property is situated. This property, which is considered an exceedingly valuable one, has been in litigation for several years, numerous suits cross-suits and interpleadings having been filed at intervals and it is feared the end is not yet. The parties who purchased to-day propose organizing a new company and pushing the development of the property at once.

S. S. Beman, architect of Chicago, has designed a nine-story apartment house for W. J. Bryson to be erected on Lake avenue between 49th and 50th streets, Chicago. It will be supported by 350 Raymond concrete piles, each 20 feet long, mixed 1 part cement, 2 parts sand and 4 parts stone. The heads of the piles will be encased in concrete and take the place of stone foundation for the building walls. The Raymond concrete pile consists of an outer sheeting of metal with a stiffening core used only for sinking the pile, after which the core is removed and concrete deposited into the shell which is next tamped and permitted to harden, when the pile is finished. The building will be 144x80 feet and cost $250,000. The building site consists largely of shifting sand formed by the wash of Lake Michigan.

The Lake Shore Portland Cement Co. expect to erect a plant at Bellaire, Mich., with L. W. Toles, president; A. B. Wooten, vice-president; C. E. Densmore, secretary, and Henry Richardi, treasurer, with a capital stock of $350,000. The citizens of the village are required to take $15,000 worth of stock, $6,000 of which has already been subscribed, each of the officers having taken $1,500, leaving $9,000 for the village to take care of.

Stamsen & Blome, the well-known contractors for cement paving and concrete construction, Unity building, Chicago, report having been awarded numerous important contracts during the month of July, and are now at work in twelve cities outside of Chicago. They recently completed 80,000 feet of cement sidewalks at Birmingham, Ala., and have been awarded contracts for 120,000 feet at Kewanee, Ill.; 168,000 feet at La Porte, Ind.; 160,000 feet at La Grange, Ill.; 60,000 feet at Wyoming, Ill.; 30,000 feet at Neponset, Ill. Also the concrete and asphalt work of the new Chicago Tribune building, the concrete fire-proofing of the large Great Western railroad freight house, the concrete work and concrete fire-proofing of St. Anne's hospital, and the concrete work of the Lessing apartments, all at Chicago, as well as a large concrete reservoir at Hammond, Ind.

Every quarry of any consequence and limestone mineral tract in central and western Pennsylvania, also eastern Ohio, have been purchased by stockholders of the steel trust. It has not been given out yet who is to be at the head of this new enterprise, though it is said that the presidency will be tendered to George W. Johnson, of New Castle, Pa., the present chairman of the Pittsburg Limestone Company. The quarries he controls have furnished the Carnegie Steel works with this mineral for the past ten years. The object of the project is the placing with one immense corporation the control of the limestone output in the section of the country named. It is the most important material needed by the blast furnaces of the U. S. Steel corporation about its Pittsburg mills and Bessemer steel cannot be made without it. It is estimated that fully $1,500,000 capital has been invested.

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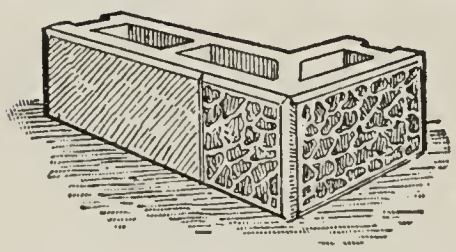

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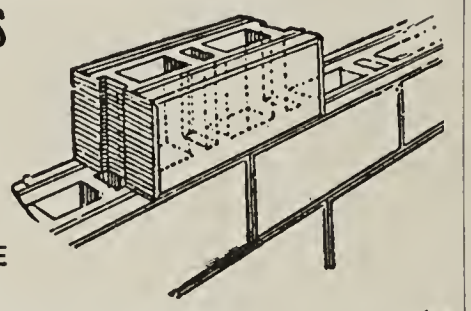

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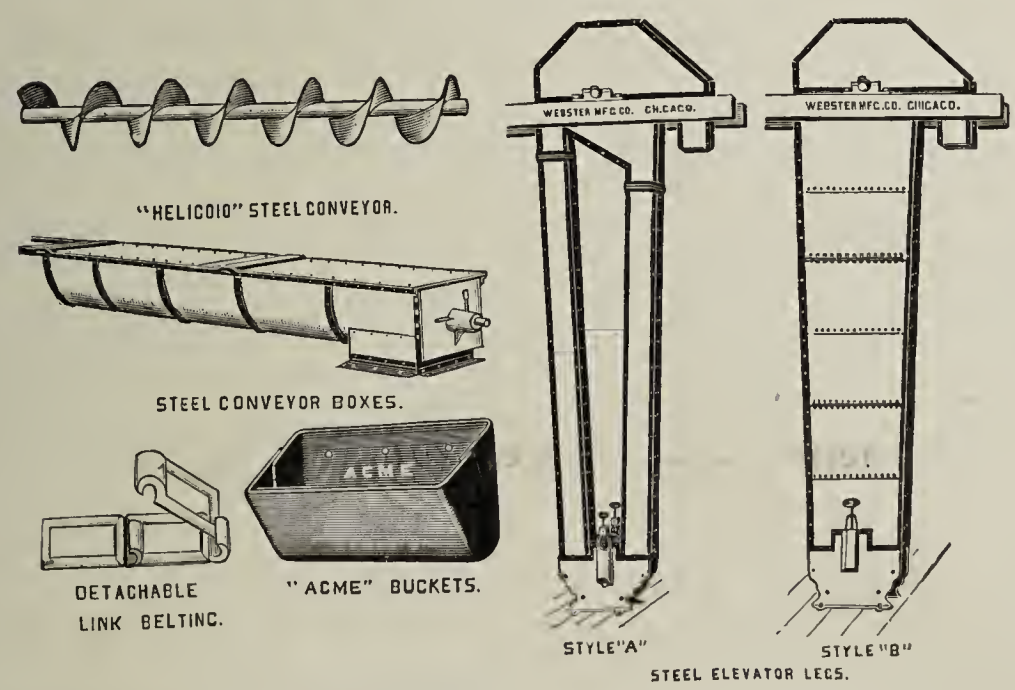

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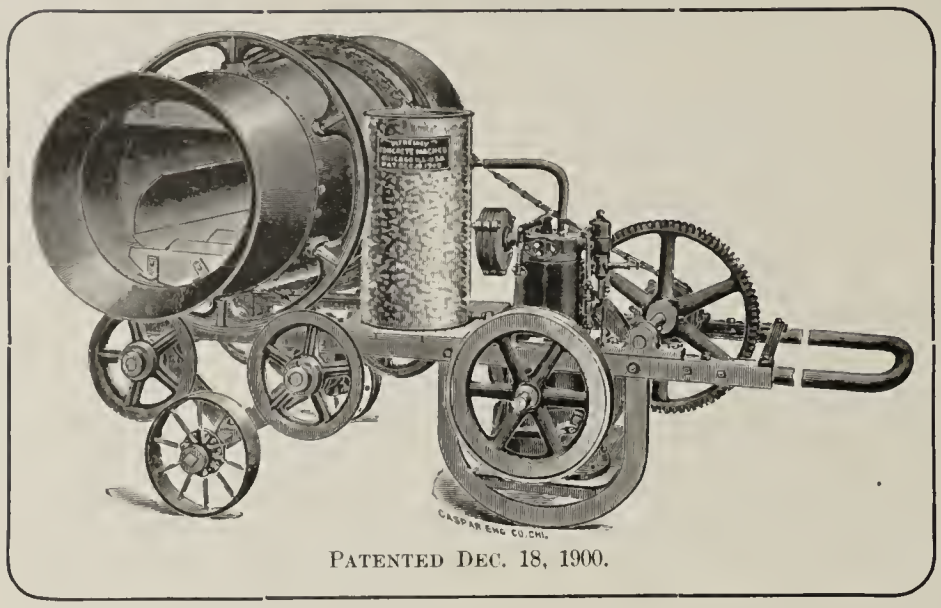

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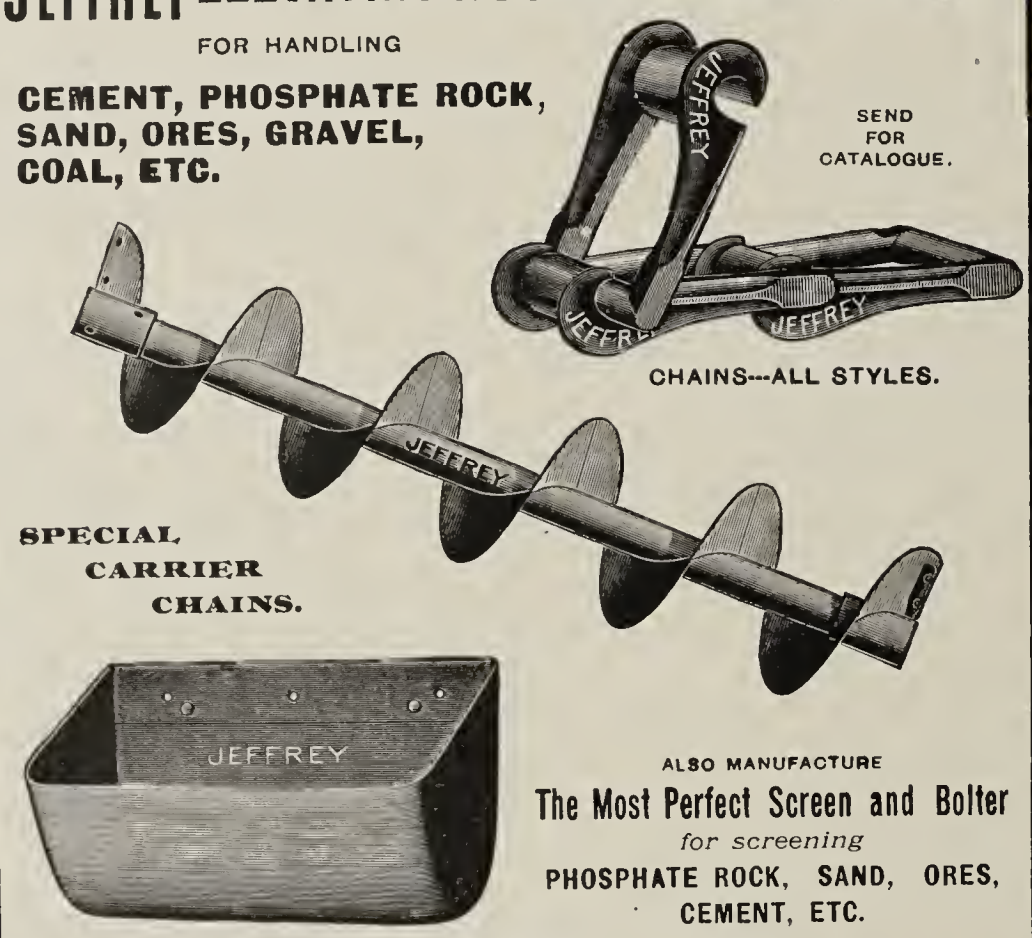

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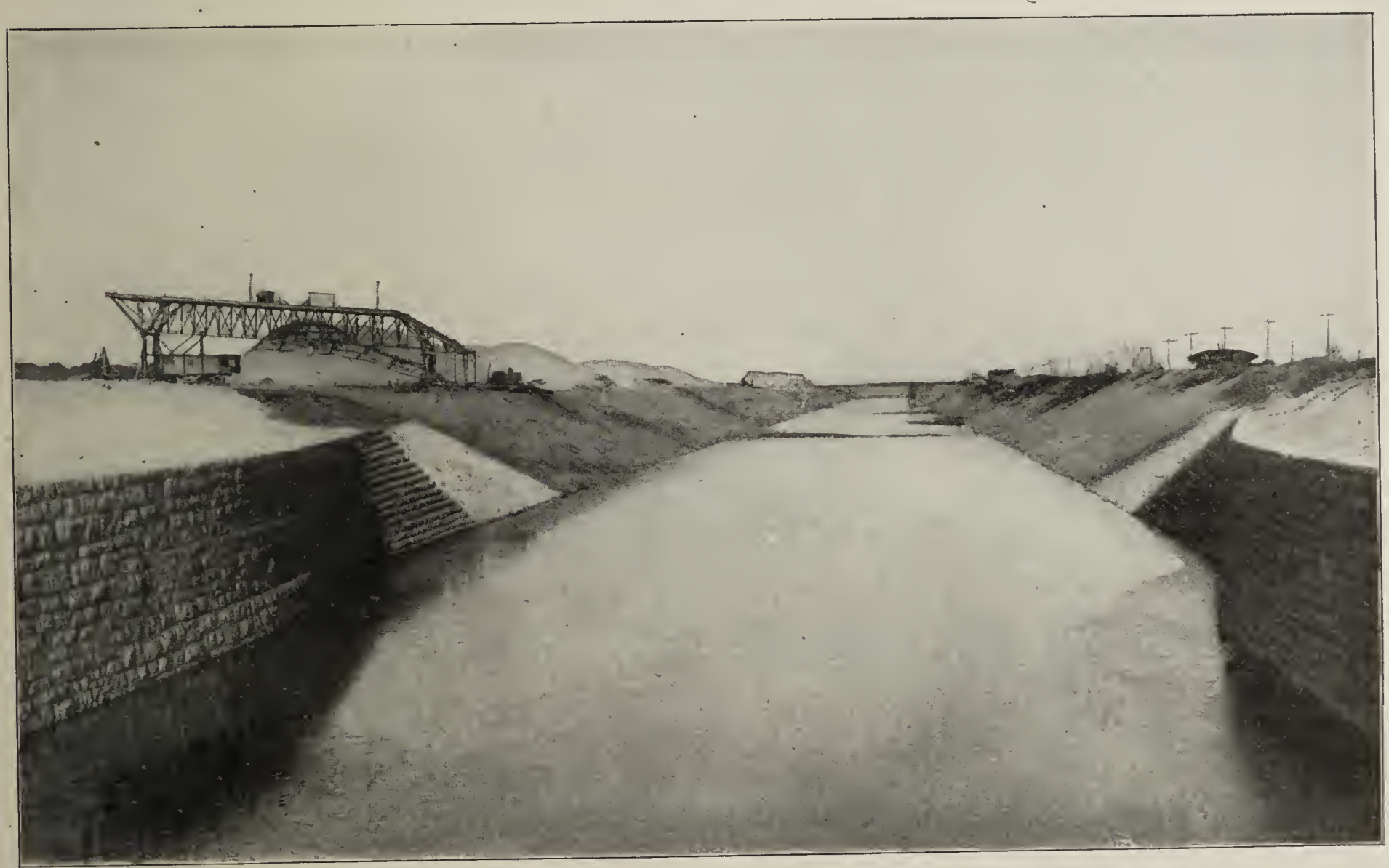

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ANARCHY—ITS VICIOUS PRECEPTS.

The assassination of the President of the United States by a fellow being, whose mind had been corrupted by the teachings of anarchy, sent a thrill of horror through the land and caused every honest man to bow his head in sorrow.

As a protest against the fiendish act of the assassin, the nation wrapped itself in sack-cloth and ashes, in order to duly bear testimony and respect of the living for the dead, mingled with words of sorrow passing from lip to lip, while scorn, defiance and retribution was hurled at anarchy, the fraud of the nineteenth century, which has trespassed upon the liberties of organized society, with its propaganda of evil sowing the seeds of discord where it can and may, proclaiming, as it does, its vicious creed to the degenerate of mankind who receive it as a gold interwoven robe of light, and under its banners of murder and despair they expect to reduce society to one common level, in which there is to be no guiding hand of authority.

We establish schools, colleges and other institutions of learning in order to improve the mental and moral status of the rising generation. To promote this end all visible property is burdened by taxation to sustain these institutions, while anarchy is seeking to undermine every moral principle and precept which we have been taught to love, honor and respect as a sacred birthright handed down to us by the founders of this nation.

Society, in the light of passing events, must proteet itself to such an extent against the propaganda of anarchy as to utterly exclude it from within our borders. We gave these people an asylum and equal liberty with ourselves; in return their teaching was the direct result of the assassination of our president. To-day they are training assassins for like ventures, and glory in it. The time has come when the strong hand of the law must point the way out of the land for anarchy—its troop of accursed behests and poisoned literature, root and branch. Let society organize in every hamlet in the land that this end may be accomplished. Let the cry be "now or never."

FIREPROOF CONSTRUCTION IN GERMANY.

Concrete, and concrete and steel constructions have the preference over all other materials in Germany for fireproofing buildings, the porous terra cotta, so extensively used in the United States in wide floor spans, being practically unknown there.

The stringent building laws enforced shut out all new systems of fireproofing until impartial practical tests have been made by the bureau of building construction.

This system of practical tests has worked to the advantage of concrete construction for fireproofing and has inspired the highest degree of confidence in this material throughout the empire on account of its excellent behavior in this respect.

The Monier system and its offshoots are most in use. Under this system light and substantial floors with spans up to 21 feet are common. The thickness of such floors being from two to three inches. The steel rods imbedded in the cement mortar give the required strength to the span. Partition walls on this system are one inch and less in thickness. This shows the extreme economy and perfection to which fireproof construction has been carried in the use of materials without sacrificing strength.

The use of Portland cement for interior finish outside of floors and partitions is much greater in Germany than in the United States. It is used in the construction of staircases, wainscoting and floor tile with the highest artistic effects.

Light and graceful stairways rise from floor to floor with tooled and polished surfaces in imitation of granite. So close has this artificial stone work been made to imitate granite that the eye can scarcely distinguish the real from the artificial without sacrificing its fire-resisting properties. There is considerable capital invested in this class of work and finds remunerative employment.

The German Emperor is a patron of this high class construction as well as of the ordinary concrete work. The new Imperial stables at Potsdam are almost entirely constructed of concrete including floors, walls, partitions, stalls and even the roof.

Berlin is a great center for concrete construction, notwithstanding the building limit is only four stories high. The rigid building laws exact a high degree of fireproof construction, therefore, the most convenient and satisfactory material, "concrete," is used to comply with the laws as enforced by the bureau of building construction.

If the same careful and impartial tests of material for fireproofing were carried out in the United States many of the buildings now installing terra cotta, lumber and hollow tile would be compelled to use concrete and in so doing would simply conform to the judicious experience and practice of the German Empire.

The county commissioners of Delaware county, Muncie, Ind., are considering the erection of a cement arch bridge over Muncie Creek at Muncie, Ind. The Union Traction Co. agree to bear part of the cost, providing the new bridge is constructed of cement.

PRODUCTION OF ASPHALTUM.

Mr. Edward W. Parker of the United States geological survey, has completed a report on the production of asphaltum and bituminous rock in 1900.

The production in 1900 shows a decrease from that of 1899 of 6,656 short tons in amount and of $62,406 in value. The production in 1900, both in amount and value, was the smallest in the last five years.

The production of bituminous sandstone decreased from 43,041 short tons in 1899 to 38,834 short tons in 1900. The value, however, increased slightly, from $123,023 in 1899 to $123,779 in 1900.

The production of hard and refined asphaltum, which includes gilsonite and varieties of similarly pure nature, decreased from 4,800 tons in 1899 to 3,700 tons in 1900, and the value fell off from $116,250 in 1899 to $86,800 in 1900.

The asphaltum and bituminous rock products in 1900 were obtained from the same five states and one territory as contributed to the production in 1898 and 1899. These were California, Colorado, Kentucky, Texas, Utah and the Indian Territory.

The production of asphaltum in the following states in 1900 was: Kentucky, 12,314 short tons of a value of $46,654; Indian Territory, Oklahoma and Texas, 15,466 short tons, value $76,482; Colorado and Utah, 3,100 short tons, value $78,500.

The island of Trinidad, off the coast of Venezuela, one of the British West Indian possessions, is, next to France, the largest producer of asphaltum in the world. The deposits are operated by an American corporation under a concession from the British government, and independently from land not belonging to the crown, and which was acquired by purchase. The chief source of supply is a lake of pitch filling the crater of an extinct volcano. The lake lies 138 feet above sea level, and has an area of 114 acres. The supply is being partly renewed by a constant flow of soft pitch into the center of the lake from a subterranean source. The shipments of lake pitch for the last ten years have averaged over 80,000 tons per year. The flow into the lake is at the rate of about 20,000 tons per year, so that the renewal of supply is less than one-fourth the amount taken out. The depth of the lake, however, is about 135 feet at the center, and, considering the extent of the deposit, there need be but little apprehension of the early exhaustion of the supply of Trinidad asphaltum. The material from this lake is known as "lake pitch." Distinctive from this is what is known as "land pitch," the overflow in past times of pitch from the lake, and deposits of similar nature, but different origin. The overflow pitch mingled with the soil, and, while it, with the other land deposits, forms another source of supply, the amount of mineral matter it contains is greater than the lake pitch, and the latter is in consequence preferred.

A NEW CEMENT COMPANY.

The articles of incorporation of the Portland Cement Co. of Portland, Colo., have been filed with the secretary of state. Capital stock, $500,000. C. Leonard, Aman Moore, James A. McCandless and Lyman Robinson, incorporators. The company has 880 acres of cement land in Fremont county, Colo., pronounced by experts to be the finest deposit in the West. The company will manufacture the "Ideal" brand of Colorado Portland cement, and by next March will be producing 1,000 barrels a day, which amount, together with the 300-barrel plant, now in operation near the same location, will be sufficient to supply the entire Rocky Mountain region from Canada to Mexico. The company's land is intersected by both the Denver & Rio Grande and Atchison, Topeka & Santa Fe railways, and work will begin at once to connect the factory site with one or both the roads.

The directors of the company for the first year are: John A. Thatcher, C. K. Boettcher, C. Leonardt, Aman Moore, M. B. Loy, Charles E. Gast and James A. McCandless. The officers elected at the first meeting of the directors, held at the company's office in Pueblo, are: John A. Thatcher, president; C. Leonardt, vice-president; M. B. Loy, secretary and treasurer, and Aman Moore, general manager.

The company will proceed immediately to construct its factory. The main building will be 100x500 feet, of structural iron with cement concrete walls and roof. An object lesson will be given to the people of Colorado in the use of Portland cement by the new company, as the roofs, wall and floors of the buildings, all foundations for machinery, storage bins, warehouses and water tanks will be constructed with Portland cement concrete with iron imbedded; also a monster smoke stack will be built of the same material.

An electric power house with two 500-horse power units will direct driven generators and water tube boilers will be constructed to supply power to operate the factory, as all machinery will be driven by electric motors. The factory will be arranged on the gravity system, to insure the most economic operation.

C. Leonardt, the vice president of the company, from Los Angeles, Cal., has had many years of practical experience in the manufacture and use of Portland cement, both in Europe and America, and Mr. Moore, the general manager of the company, is also a cement chemist and manufacturer of many years' experience, being one of the pioneers of the American Portland cement industry. Mr. Leonardt and Mr. Moore will at once go East to get bids on machinery for the factory and active work will begin immediately on their return.

The Illinois Central railway is constructing a double track concrete bridge over the Big Muddy river two miles north of Carbondale, Ill., consisting of three spans, each 160 feet in length. With the approaches the entire length will be 580 feet.

The German Portland Cement Co.'s plant at White Pigeon, Mich., is under fair progress. The walls of the buildings are being constructed of concrete and have reached a height of from 7 to 14 feet. The roof of the power house is about ready to be placed. The rotary kiln foundations are about finished.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	JULY.				SEVEN MONTHS ENDING JULY.			
	1900.		1901.		1900.		1901.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	3,949,190	14,867	200,000	761	52,087,187	202,623	1,592,740	6,248
Belgium..	15,138,248	41,508	19,330,171	61,074	170,446,375	491,938	47,300,746	140,962
France	8,073,420	27,784	.....	.....	10,828,272	39,207	2,366,722	9,746
Germany.....	17,465,049	55,984	13,657,628	80,094	246,552,433	935,863	113,890,190	433,278
All Other Europe ...	3,653,571	12,229	656,241	1,833	19,511,033	66,001	6,394,262	16,979
British North Am...	262,500	1,614	75,400	459	865,550	4,623	1,089,199	5,265
Other Countries.....	240,000	1,011	300,000	1,286	4,622,060	20,983	1,816,271	7,708
TOTAL	48,781,978	154,997	34,219,440	145,507	504,912,910	3,270,916	174,450,130	620,186
Domestic Exports of Cements, bbls.	3,385	7,213	39,670	79,241	45,033	98,490	199,158	384,127

There were 8,377,813 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on July 30, 1900, valued at $28,868, against 8,043,295 lbs., valued at $26,051 on July 30, 1901.

Imports of asphaltum or bitumen for July, 1900, were 11,482 tons valued at $33,172; July, 1901—15,845 tons valued at $68,920. For seven months ending July, 1900, 56,388 tons valued at $207,486; for seven months ending July, 1901—83,634 tons valued at $335,507.

TESTING HYDRAULIC CEMENTS.—I.

Report of Major William L. Marshall, Major Smith S. Leach and Capt. Spencer Cosby, Corps of Engineers, U. S. A., being Professional Paper 28 of the Corps.

The constructing engineer is confronted by no problem more difficult than to decide whether a certain cement, when placed in a work, will behave in a predetermined way. This is especially true of Portlands. Other cements are much more reliable under conditions of exposure for which they are suited.

The difficulties arise from the fact that tests for acceptance or rejection must be made on a product not in its final stage. A cement, when incorporated in masonry, undergoes for months chemical changes in the process of setting, so that the material subjected to strains in the work is not the material tested, but a derivative of it. The object of tests is to establish two probabilities: First, that the product of the given cement will develop the desired strength and hardness soon enough to enable it to bear the stresses designed for it; second, that it will never thereafter fall below that strength and hardness. Up to the present time it appears that the relation between the chemical and physical properties of raw cement and of its partially indurated derivatives, determined by tests, and the physical properties of the same cement or its derivatives, after complete hydration and induration in the work, can be stated only within rather wide limits.

The most useful tests of cements are those, first, which connect themselves definitely with some serious defect to which cements are subject, or with some merit which they should possess; second, which can be made with the least apparatus and manipulation, and which give their indications in the shortest time; and, third, which are freest from personal equation and from influences of local surroundings. These criteria, applied to the customary tests of cements, give indications as to their relative value and the best methods of making them.

Test of grinding.—This test derives importance from the fact, apparently well established, that, other things being equal, the finer the cement the greater will be its sand-carrying capacity; that is, it will show greater strength with the same charge of sand, or equal strength with a greater charge. According to the best information the board can obtain, the cementitious value of this material is believed to reside principally, if not wholly, in the very fine part. It follows that a grinding test should be directed to determining the proportion which is very fine rather than the residue above a certain size. The board does not propose any change in the accepted grinding test of Portland cement, but favors for natural cement the use of the same size screen as for Portland, No. 100, with the requirement that 80 per cent shall pass through it. The screen should be frequently examined, magnified, if practicable, to see that no wires are displaced, leaving apertures larger than the normal.

Test for specific gravity.—This test is made with simple appliances, and its result is immediately known. It appears to connect itself quite definitely with the degree of calcination which the cement has received. The higher the burning, short of vitrification, the better the cement and the higher the specific gravity.

This test has another value, in that the adulterations of Portland cement most likely to be practiced and most to be feared are made with materials which reduce the specific gravity. The test is therefore of value in determining a properly burned, non-adulterated Portland. If underburned, the specific gravity may fall below 3; it may reach 3.5 if the cement has been overburned. No other hydraulic cement is so heavy in proportion to volume, natural cement having a specific gravity of about 2.5 to 2.8 and puzzolan (slag) of about 2.7 to 2.8. Properly burned Portland, adulterated with slag, will fall below 3.1.

Test of activity.—This test, made by gauging the cement with water and observing the times of initial and permanent set, is partly direct and partly indirect. It is direct in so far as its limits relate to the time necessary to get the cement in place after mixing, which must not be greater than the time of initial set, and to the time within which the cement product must take its load, which must not be less than the time of permanent set. It is indirect in so far as its limits relate to the probable final strength, elasticity and hardness of the cement mixtures. In the latter respect it appears to be reasonably well established that cements exhibiting great activity give, after long periods, results inferior to those with action less rapid.

The test for activity is easily made with simple appliances, and its results are known in a few hours at most. Variable results in the test are caused by different local conditions of moisture and temperature and by the different judgments of observers as to whether the needles penetrate or not. Generally speaking, both periods of set are lengthened by increase of moisture and shortened by increase of temperature. Some manufacturers claim that their cements show their best results when gauged with particular percentages of water. It is not considered good policy to encourage these peculiarities at the expense of the uniformity of tests which is so greatly desired. It is better to adopt a definite proportion of water for gauging and require all cements of the same class to stand or fall on their showing when so gauged. Such a percentage, adopted and known, will probably be used by manufacturers in testing goods sold to the engineer department, and a greater harmony between mill and field tests of the same cement will result.

In gauging Portland cement in damp weather the samples should be thoroughly dried before adding water. This precaution is not deemed necessary with natural cement. Sufficient uniformity of temperature will result if the testing room be comfortably warmed in winter and the specimens be kept out of the sun in a cool room in summer, and under a damp cloth until set.

Test for constancy of volume.—This test results from observations made on the pats or cakes used in the setting test. It derives its value from its connection with the quantity of expansives in the cement.

The test is easy to make, and its results are relatively free from personal error, though there is room for a difference of judgment as to the appearance of the cakes. As they may be preserved and the decision reviewed at any time on the original data, such differences are immaterial.

Tests of strength.—These may be subdivided into compressive and tensile tests, the latter including the transverse test made by breaking a beam of the cement. The compressive test need not be further considered, as it is less easily made than the tensile test and gives no surer indications. The ratio of compressive to tensile strength of the same class of cements is quite uniform.

Of the tensile tests the direct pull is preferable to the flexure test.

The tensile test is theoretically a perfect index of the quality of the cement at the periods of test, and a comparison at different periods gives the best obtainable indication of what its subsequent conduct will be. In the opinion of the board the two periods most generally adopted, 7 and 28 days after mixing, are, on the whole, the best. The one-day test, though of some value in a discriminating sense, should not be placed in the same category as the other periods named.

The apparatus for tensile tests is somewhat elaborate and delicate, but is of standard manufacture and readily obtainable at relatively small cost.

In respect of uncertainties due to the personal equation of the tester

and to the influence of local conditions this test presents greater difficulties than any of the others considered. The most scrupulous care must be observed in the manipulations, and the tester should possess natural aptitude for such work. The object is to determine the greatest stress per square inch which the cement can be made to stand under given conditions without rupture. If the conditions have been carefully observed and several discrepant results are obtained, the highest may be right, but the others are certainly wrong. No averaging should be done.

The remarks made above under the activity test as to the relation between early hydraulic intensity and the final excellence of a cement product are equally applicable to the indications from tensile tests. A cement which tests moderately high at 7 days and shows a substantial increase to 28 days is more likely to reach the maximum strength slowly and retain it indefinitely with a low modulus of elasticity than a cement which tests abnormally high at 7 days with little or no increase at 28 days.

Accelerated tests.—The rules recommended by the committee of the American Society of Civil Engineers in 1885 have been substantially accepted here and abroad as to tests of setting qualities and soundness; more rapid tests for soundness are, however, proposed and practiced, though no accelerated test has been generally accepted.

Accelerated tests proposed for the speedy detection of the presence of expansives in cement usually consist in the application, after gauging, of dry heat or of immersion in warm or boiling water or steam. The immersion tests are most in vogue. They vary from immersing freshly gauged pats on glass plates in water at 115 degrees Fahr. for 24 hours, or at higher temperatures for various periods, to steaming or boiling cakes or cylinders of the material to be tested at 212 degrees Fahr. for varying times.

In France and Germany the swelling or expansion of boiled cylinders is measured directly by calibration. Usually change of volume not accompanied by visible evidences of it—i. e., distortion or disruption—is not observed in American tests prescribed in specifications for the reception of cements. Of all these tests the boiling test is the simplest, requires only apparatus everywhere available, and is recommended by the board. It has been the experience that this test detects material that is unsound by reason of the presence of active expansives; but in some cases it rejects material that would give satisfactory results in actual work and will reject material that would stand this test after air slaking.

The great value of the test lies in its short time indications and in at once directing attention to weak points in the cement to be further observed or guarded against. Of two or more cements offered for use or on hand, the cements that stand the boiling tests are to be taken preferably; it should be constantly applied on the work among other simple tests to be noted, for although the boiling test sometimes rejects suitable material, it is believed that it will always reject a material unsound by reason of the existence of active expansives. Sulphate of lime, while enabling cements to pass the boiling tests, introduces au element of danger.

This test is proposed as suggestive or discriminative only. Except for works of unusual importance it is not recommended that a cement passing the other tests proposed shall be rejected on the boiling test.

Tests to be made.—For selecting Portland and puzzolan cement from among the brands offered, the board recommends that the following tests be made: 1, For fineness of grinding; 2, for specific gravity; 3, for soundness or constancy of volume in setting; 4, for time of setting; 5, for tensile strength.

For natural cement we recommend the omission of the specific-gravity and soundness tests.

On the works the board recommends simple tests when the more elaborate tests cannot well be made.

In determining the minimum requirements for cements given in the subjoined specifications we recognize that many cements that attain only fair strength neat and with sand in a short time and show marked gains of strength on further time will fulfil the requirements of the service, and that unusually high tensile strength attained in a few days after gauging is often coupled with a small or negative increase in strength in further short intervals. Unusually high tests in a short time after gauging should be regarded with suspicion, although some well-known brands of American cements show great strength in short-time tests and, so far as observed, are reliable in air and fresh water. Cements offered under such known brands should show their characteristic strength and other qualities or be suspected as spurious or adulterated, if not rejected, even though the minimum requirements of the specifications are met. The practice of offering a bonus or free gift of money in addition to the contract price for cement testing above a fixed high point should be prohibited as unnecessary, for cements so obtained are likely to be unsound in a manner not easily detected in the time usually available in testing.

It is believed that most of the very high testing Portland cements have lime in excess, the effect of which is temporarily masked by the use of sulphate of lime. Overlimed cements so treated are unfit for use in sea water. For such uses a chemical analysis should be required, and the quantity of sulphuric acid, as well as magnesia, be limited to a low percentage. It is not yet known that sulphate of lime in quantity less than 2 per cent is injurious to cements to be used in fresh water or in air. It masks expansives that might ultimately cause the destruction of the work, but it is not known whether this effect is permanent. Its addition is now deemed necessary to control time of setting. It makes a quick-setting cement slow setting, at the same time increasing tensile strength acquired in short time.

Manipulation of cements for tests.—I, Fineness.—Place 100 parts (denominations determined by subdivisions of the weighing machine used) by weight on a sieve with 100 holes to the linear inch, woven from brass wire No. 40, Stubb's wire gauge; sift by hand or mechanical shaker until cement ceases to pass through.

The weight of the material passing the sieve plus the weight of the dust lost in air, expressed in hundredths of the original weight, will express the percentage of fineness. In order to determine this percentage the residue on the sieve should be weighed.

It is only the impalpable dust that possesses cementitious value. Fineness of grinding is therefore an essential quality in cements to be mixed with sand. The residue on a sieve of 100 meshes to the inch is of no cementitious value, and even the grit retained on a sieve of 40,000 openings to the square inch is of small value. The degree of fineness prescribed in these specifications (92 per cent) for Portland through a sieve of 10,000 meshes to the square inch is quite commonly attained in high-grade American cements, but rarely in imported brands. On the Pacific coast, where foreign cements only are in the market, this requirement may be lowered for the present to 87 per cent on No. 100 sieve.

II, Specific gravity.—The standard temperature for specific gravity determinations is 62 degrees Fahr., but for cement testing temperatures may vary between 60 and 80 degrees Fahr. without affecting results more than the probable error in the observation.

Use any approved form of volumenometer or specific gravity bottle, graduated to cubic centimeters with

decimal subdivisions. Fill instrument to zero of the scale with benzine, turpentine or some other liquid having no action upon cements.

Take 100 grams of sifted cement that has been previously dried by exposure on a metal plate for twenty minutes to a dry heat of 212 degrees Fahr., and allow it to pass slowly into the fluid of the volumenometer, taking care that the powder does not stick to the sides of the graduated tube above the fluid and that the funnel through which it is introduced does not touch the fluid.

Read carefully the volume of the displaced fluid to the nearest fraction of a cubic centimeter. Then the approximate specific gravity will be represented by 100 divided by the displacement in cubic centimeters.

The operation requires care.

III, Setting qualities and soundness.—The quantity of water and the temperature of water and air affect the time of setting. The specifications contemplate a temperature varying not more than 10 from 62 degrees Fahr., and quantities of water given herein:

For Portland cements use 20 per cent of water.

For puzzolan cements use 18 per cent of water.

For natural cements use 30 per cent of water.

Mix thoroughly for five minutes, vigorously rubbing the mixture under pressure; time to be estimated from moment of adding water and to be considered of importance.

Make on glass plates two cakes from the mixture about 3 inches in diameter, $\frac{1}{2}$ inch thick at middle, and drawn to thin edges, and cover them with a damp cloth or place them in a tight box not exposed to currents of dry air. At the end of the time specified for initial set apply the needle one-twelfth of an inch diameter weighted to $\frac{1}{4}$ pound to one of the cakes. If an indentation is made the cement passes the requirement for initial setting, if no indentation is made by the needle it is too quick setting. At the end of the time specified for "final set" apply the needle one twenty-fourth of an inch diameter loaded to one pound. The cement cake should not be indented.

Expose the two cakes to air under damp cloth for 24 hours. Place one of the cakes, still attached to its plate, in water for 28 days; the other cake immerse in water at about 70 degrees temperature supported in a rack above the bottom of the receptacle; raise the water gradually to the boiling point and maintain this temperature for six hours and then let the water with cake immersed cool. Examine the cakes at the proper time for evidence of expansion and distortion. Should the boiled cake become detached from the plate by twisting and warping or show expansion cracks the cement may be rejected, or it may await the result of 28 days in water. If the fresh-water cake shows no evidences of swelling, the cement may be used in ordinary work in air or fresh water for lean mixtures. If distortion or expansion cracks are shown on the fresh-water cake, the cement should be rejected.

Of two or more cements offered, all of which will stand the fresh-water cake test for soundness, the cements that will stand the boiling tests also are to be preferred.

IV, Tensile strength.—Neat tests. Use unsifted cements. Place the amount to be mixed on a smooth, non-absorbent slab; make a crater in the middle sufficient to hold the water; add nearly all the water at once, the remainder as needed; mix thoroughly by turning with the trowel, and vigorously rub or work the cement for five minutes.

Place the mold on a glass or slate slab. Fill the mold with consecutive layers of cement, each when rammed to be $\frac{1}{4}$ inch thick. Tap each layer 30 taps with a soft brass or copper rammer weighing 1 pound and having a face $\frac{3}{4}$ inch diameter or 0.7 inch square with rounded corners. The tapping or ramming is to be done as follows: while holding the forearm and wrist at a constant level, raise the rammer with the thumb and forefinger about half an inch and then let it fall freely, repeating the operation until the layer is uniformly compacted by 30 taps.

This method is intended to compact the material in a manner similar to actual practice in construction, when a metal rammer is used weighing 30 pounds, with circular head 5 inches in diameter falling about 8 inches upon layers of mortar or concrete 3 inches thick. The method permits comparable results to be obtained by different observers.

After filling the mold and ramming the last layer, strike smooth with the trowel, tap the mold lightly in a direction parallel to the base plate to prevent adhesion to the plate, and cover for 24 hours with a damp cloth. Then remove the briquette from the mold and immerse it in fresh water, which should be renewed twice a week for the specified time if running water is not available for a slow current. If molds are not available for 24 hours, remove from the molds after final set, replacing the damp cloth over the briquettes. In removing briquettes before hard-set, great care should be exercised. Hold the mold in the left hand and, after loosening the latch, tap gently the sides of the mold until they fall apart. Place the briquettes face down in the water trough.

For neat tests of Portland cement use 20 per cent of water by weight.

For neat tests of puzzolan cement use 18 per cent of water by weight.

For neat tests of natural cement use 30 per cent of water by weight.

Nearly all this water is retained by Portland cement, whereas only about one-third of the gauging water is retained by puzzolan or natural cements; from this it follows that an apparent condition of plasticity or fluidity that ultimately little injures Portland paste, very seriously injures puzzolan or natural mortars and concretes by leaving a porous texture on the evaporation of the surplus water.

Sand tests. The proportions 1 cement to 3 sand are to be used in tests of puzzolan and Portland, and 1 cement to 1 sand in tests of natural or Rosendale cements. Crushed quartz sand, sifted to pass a standard sieve with 20 meshes per linear inch and to be retained on a standard sieve with 30 meshes to the inch, is to be used.

After weighing carefully, mix dry the cement and sand until the mixture is uniform, add the water as in neat mixtures, and mix for five minutes by triturating or rubbing together the constituents of the mortar. This may be done under pressure with a trowel or by rubbing between the fingers, using rubber gloves. The rubbing together seems necessary to coat thoroughly the facets of sand with the cement paste.

It is found that prolonged rubbing, when not carried beyond the time of initial set, results in higher tests. Five minutes is the time of mixing quite generally adopted in European specifications. The briquettes are to be made as prescribed for neat mixtures.

Portland cements require water from 11 to $12\frac{1}{2}$ per cent by weight of constituent sand and cement for maximum strength in tested briquettes.

Puzzolan, about 9 to 10 per cent.

Natural, about 15 to 17 per cent.

Mixtures that at first appear too dry for testing purposes often become more plastic under the prolonged working required herein.

In general, about four briquettes constitute the maximum number that may be made well within the time required for initial setting of moderately slow setting cements.

Three such batches of sand mixtures should be made, and one briquette of each batch may be broken at 7 and 28 days, giving three tests at each period. At least one batch of neat cement briquettes should be made.

If the first briquette broken at each date fulfils the minimum requirement

of these specifications it is not necessary to break others, which may be reserved for long-time tests.

If the first briquette does not pass the test for tensile strength, then briquettes may be broken until six briquettes, two from each batch, have been broken at 7 days, and the remaining six reserved for 28-day tests. The highest result from any sample is to be taken as the strength of the sample when the break is at the least section of briquette.

If, on the 28-day tests, the cement not only more than fulfils the minimum requirements of these specifications, but also shows unusual gain in strength, it may still be accepted if the other tests are satisfactory, notwithstanding a low seven-day test, if early strength is not a matter of importance. Such cements are likely to be permanent.

For a batch of four briquettes, the following quantities are suggested as in accord with these specifications. Water is measured by fluid-ounce volumes, not by weight, temperature varying not more than 10 from 62 degrees Fahr.

Portland cement: Neat: 20 ounces of cement, 4 ounces of water. Mix wet five minutes.

Sand: 15 ounces sand, 5 ounces cement, $2\frac{1}{2}$ ounces water. Mix thoroughly dry; then mix wet five minutes.

Puzzolan cement: Neat: 20 ounces cement, $3\frac{3}{4}$ ounces water. Mix wet five minutes.

Sand: 15 ounces sand, 5 ounces cement, 2 ounces water. Mix thoroughly dry; then mix wet five minutes.

Natural cement: Neat: 20 ounces cement, 6 ounces water. Mix wet five minutes.

Sand: 10 ounces cement, 10 ounces sand, $3\frac{1}{2}$ ounces water. Mix dry; then wet for five minutes.

For measuring tensile strength, a machine that applies the stress automatically at a uniform rate is preferable to one controlled entirely by hand.

These specifications for tensile strength contemplate the application of stress at the rate of 400 pounds per minute to briquettes made as prescribed herein. A rate so rapid as to approximate a blow or so slow as to approximate a continued stress will give very different results.

The tests for tensile strength are to be made immediately after taking from the water or while the briquettes are still wet. The temperature of the water during immersion should be maintained as nearly constant as practicable; not less than 50 nor more than 70 degrees Fahr.

The tests are to be made upon briquettes 1 inch square at place of rupture. The specifications contemplate the use of the form of briquette recommended by the committee of the American Society of Civil Engineers, held when tested by close-fitting metal clips, without rubbing or other yielding contacts. The breaks considered in the tests are to be those occurring at the smallest section, 1 inch square.

Simple tests.—Tests of cement received upon a work in progress must often be of much simpler character than prescribed herein.

Tests on the work are mainly to ascertain whether the article supplied is genuine cement, of a brand previously tested and accepted, and whether it is a reasonably sound and active cement that will set hard in the desired time, and give a good, hard mortar. Simple tests may give this information, and such should be multiplied whether or not more elaborate tests be made. Pats and balls of cement and mortar from the storehouse and mixing platform or machine should be frequently made. The setting or hardening qualities, as determined roughly by estimating time and by pressure of the thumb nail, should be observed; the hardness of the set and strength, by cracking the hardened pats or cakes between the fingers, and by dropping the balls from the height of the arm upon a pavement or stone and observing the result of the impact.

By placing the pats in water as soon as hardened sufficiently and raising the temperature to the boiling point for a few hours and observing the character and color of the fracture after sufficient immersion, information as to the character of the material, whether hydraulic or Portland or puzzolan, whether too fresh or possibly "blowy," may be speedily and quite well ascertained without measuring instruments.

Many engineers and users of cements regard such simple tests, taken in connection with the weight and fineness of the cement and the apparent texture and hardness of the mortars and concretes in the work, sufficient field tests of a material of known repute. The more elaborate tests, described above, should be made in well-equipped laboratories by skilled cement testers.

(TO BE CONTINUED.)

Seventy thousand square feet of cement driveways will be laid on the University of Chicago campus during the present season. A driveway will be extended across the entire campus from the Hull gate to the Midway, passing Haskell Hall. Fifty-Ninth street will be paved from Divinity Hall to Nancy Foster Hall, along the Midway.

PROTEST AGAINST CEMENT CURBS.

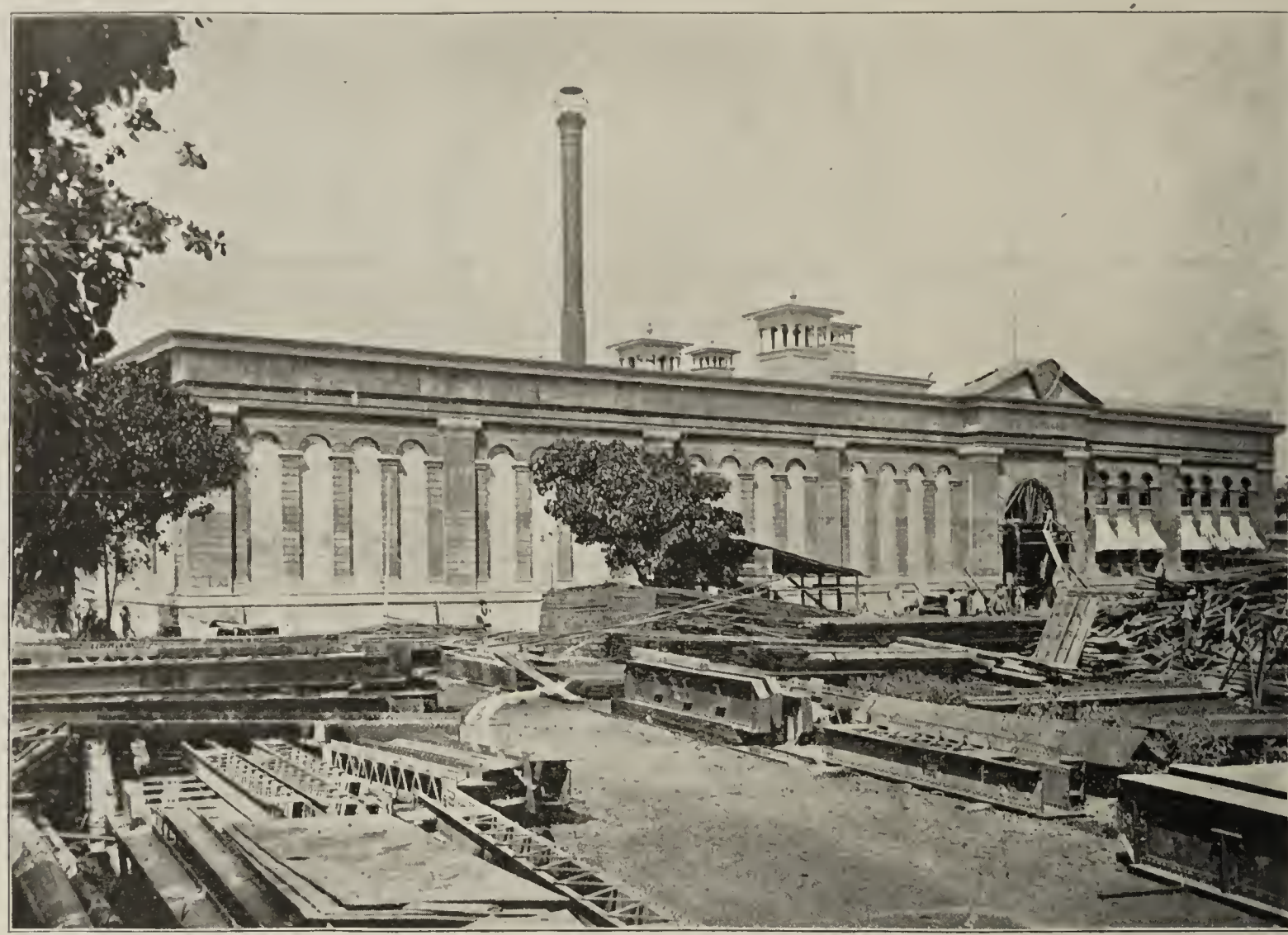
The Denver board of public works recently met a committee which called to protest against the use of Portland cement curbs and gutters in one of the contemplated Capitol hill grading and curbing districts. The delegation was composed of State Labor Commissioner Smith, President H. E. Garman of the state federation of labor, Roady Kenehan of the state board of arbitration, and C. Wright, H. Schamel and L. Gabriel, constituting a committee from the trades assembly, appointed at the request of the stonecutters' union.

The committee informed the board that if stone were not used for curbing in Denver, it would operate to discourage its use in other cities. The protestants said at the present time cities like Omaha were taking Colorado stone curbs dressed by Colorado workmen. The protestants expressed the belief that the proposed concrete curbs and gutters would be worthless in a few years—at least by the time the guarantees expired, and that this fact ought to be considered by the officials as a reason for desiring stone. Many features of the controversy were gone over but the delegation failed to convince the board that the specifications for the district bounded by Broadway, Downing, Sixth and Eleventh avenues should be altered.

President Speer of the board, in replying, informed the delegation that property owners had asked for concrete curbs and gutters in this improvement district, and that even if concrete gutters were used in Denver there would yet be ample employment for the stone contractors. He stated that at the present time every quarry in Colorado is producing up to the limit of its capacity, a fact demonstrated by the inability of citizens to secure flagstones for sidewalks in the downtown sections.

The board expects to complete the ordinance for the district in which it is proposed to lay concrete curb and gutter at once, and will send it to the council without further delay.

The Israel Gingerich farm of 160 acres, near Palmyra, Pa., was purchased to-day by Simon P. Light and Clinton J. Barr, both of Lebanon, Pa., for $25,000. A cement plant is to be erected on the propert. A corporation is to be formed with several million dollars capital, of which Robert K. Cassatt of Philadelphia is said to be the leading stockholder. The purchasers of the land have had experts on the ground for some time to determine the suitability of the materials for Portland cement manufacture.



UNITED STATES GOVERNMENT REFRIGERATION PLANT AT MANILA.

UNITED STATES GOVERNMENT REFRIGERATION PLANT AT MANILA.

The United States Army Refrigerating Plant at Manila is constructed ofconcrete. The building is 255 feet square. The foundations are molded concrete blocks resting on concrete piling, 40 feet deep. The entire outer walls are of the same material, molded in place and backed with brick. The stack is 176 feet high. The base covers an area of 1,600 feet, built up 18 feet high of concrete, lined with brick; the next 55 feet is brick, octagon in shape; the remaining 103 feet is steel, except, the extreme top which is copper. The plant is equipped with two refrigerating machines of 125 tons daily capacity each. Fifty tons of ice are produced daily for packing meats shipped and for local use. The equivalent of 200 tons of ice is used for cold storage purposes. The manual labor used in the erection of the plant was Japanese and natives. The Japanese were paid $2.00 per day, (Mexican) while the natives received $1.00 per day, Mexican silver. Mr. H. F. Huestis of Chicago, assistant to the United States engineer in charge of the erection of the plant, spent two years at Manila, without a day's sickness. The brick was manufactured at Manila. The cement came from the Green Island Portland Cement Company's plant at Green Island off the coast of Macao, China.

DRAINING THE ZUIDER ZEE.

It is more than fifty years since this project was first under contemplation by the Dutch government and people. "The scheme proposed," says *The National Geographic Magazine*, "would restore to cultivation and habitation a tract of land comprising about 490,000 acres. This land was submerged in the terrible storms of the ninth and twelfth centuries, and has since been lying at an average depth of ten feet below the surface of the sea. It is reckoned that the cost of this restoration would be something like $50,000,000, but that the value of the reclaimed land would repay the cost at least three times over. At present the Zuider Zee is too shallow for navigation, and its shores are constantly inundated and hardly better than swamps. It is proposed to construct a dike, twenty-eight miles in length, from Enkhuizen to the river Yssei, and by steam-pumps to remove the water south of this dike. Through the reclaimed area canals are to be made, with railroads along their banks. Thus distances would be shortened—Friesland and North Holland, for example, being thirty miles nearer by railway than at present. A new province, to be called Wilhelminaland, would be added to the Netherlands, and the territory of the little kingdom would be increased one-sixteenth. Various modifications have recently been proposed in the comprehensive plan submitted by the Dutch engineers in 1870, and it is still an open question whether the entire project will be undertaken, and if so, when. The time requisite for completion of the drainage is estimated by different experts as from twelve to thirty-six years.

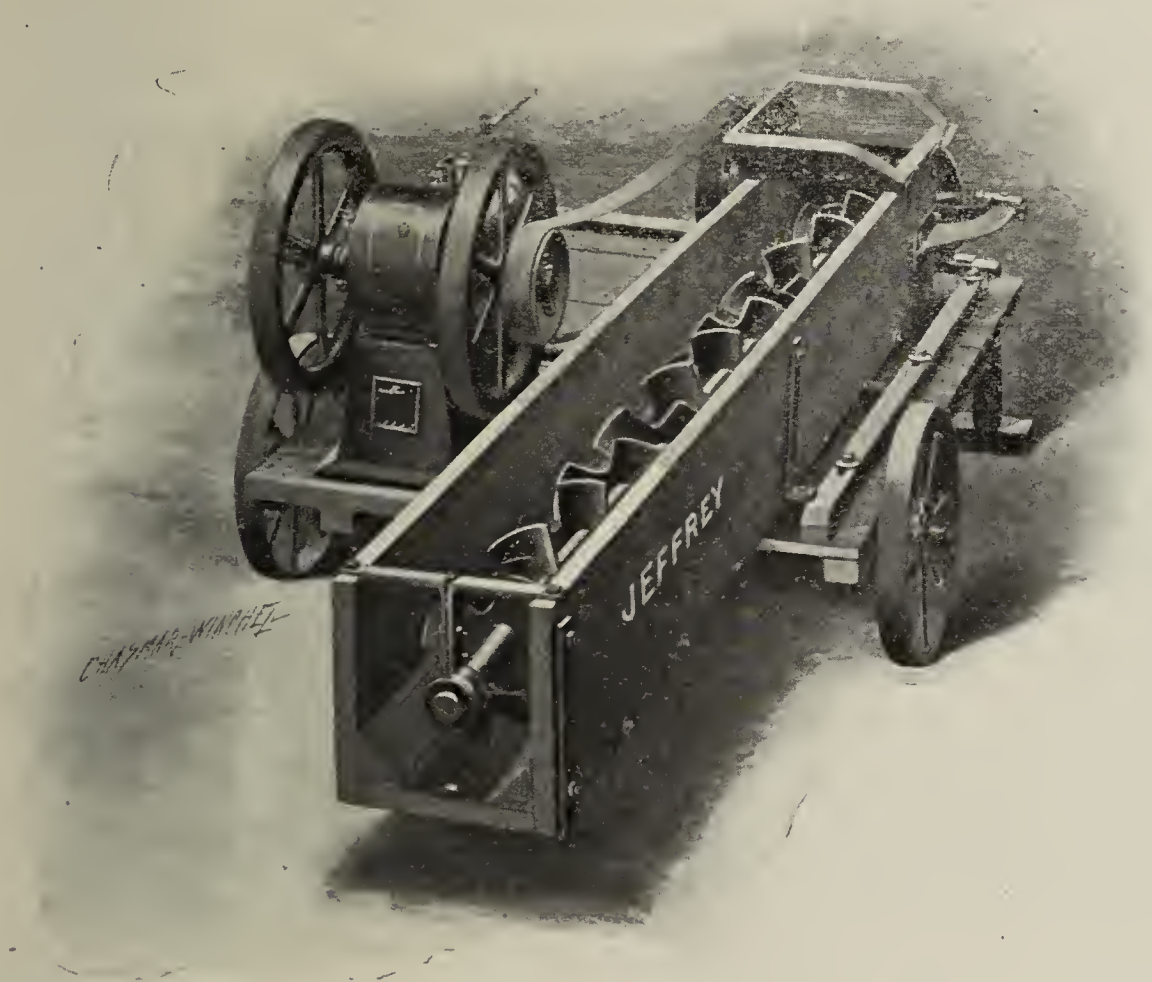
Specifications for concrete sidewalks at Wheaton, Ill., under an ordinance recently passed provide that the ground shall be excavated to form a sub-grade 13 inches below the pavement level, the surface to be compacted and then covered with 10 inches of clean gravel or cinders. Upon this bed will be laid a 3-inch course of concrete, composed of 1 part Portland cement, 2 parts sand and (after cement and sand have been mixed dry) 5 parts broken stone not exceeding 2½ inches in greatest dimensions. Clean water will then be added in sufficient quantity to give a surplus of moisture when rammed. Upon this will be a finishing coat composed of 1 part imported Portland cement and 1 part torpedo gravel. The concrete and finishing coat will be laid in alternating sections, 5 feet in length and 5 feet apart, the alternate sections to be filled in after the first ones have set. The walks must be at least 4 feet wide, with a slope towards the curb of 1 in 36.

MORTAR AND CONCRETE MIXER.

The accompanying illustration represents a model mortar and concrete mixer made by the Jeffrey Manufacturing Company of Columbus, Ohio.

As will be seen, the mixing trough, which is substantially built of wood and iron, is supplied with a special spiral conveyor made so as to cut, turn over and thoroughly mix the material, at the same time carrying it to the end of the box. This machine has been built for mixing mortar, sand, concrete, cement and similar material and has proved a perfect success.

The power is furnished by gas or gasoline engine, the connection being made by means of pulleys and gears. The engine, mixer and driving connections are mounted on a platform provided with wheels and axles. The platform has a hinged leg at one end and a tongue at the other. The leg serves as a support while the mixer is in use, the tongue for moving it from place to place by attaching it to the rear end of a wagon. The mixer is also sold without the platform and arranged to be driven by horse power when desired. In these days no contractor doing extensive work can afford to be without a machine of this kind. The machine mixes the mortar thoroughly in a uniform manner, producing a product far superior to hand mixing, enabling the masons to accomplish more work than where hand mixed mortar is used. For concrete work it is specially adapted, as it can be readily moved from place to place, discharging the material directly where it is to be used. This machine will pay for itself within a short time, and its cost puts it within the reach of all contractors. For further information and prices address the manufacturers.



CONCRETE SEWER.

The extension of the Charles street sewer at St. Joseph, Mo., which is to be built at a cost of about $8,000 will be of solid concrete. This will be the first sewer of its kind in St. Joseph, and probably in in the West.

Concrete for sewer building has been used for some time in the larger cities of the East and its advantages over brick or stone are manifold. The cost is about 25 per cent more than brick, but the durability, it is said, more than repays the additional outlay. The Charles street sewer will be one of the most important undertakings of the year in the city engineering department, and its construction will be an interesting sight, even to those who are not familiar with work of this kind.

It will be necessary to put in about fifty piles to support the foundation, which, like the sewer proper, will be of solid concrete. It is estimated that 1,000 lineal feet of piling will be required. Upon these piles the foundation will be laid. The unusual portion of the work will be the erection of the sewer proper. The material will be prepared out of limestone, crushed to the size of an inch and a half mesh, and mixed with sand and cement. This mixture will be laid in wooden molds and will there be allowed to solidify. When it has become "set," as the contractors say, the framework will be removed and the sewer will be ready for use.

It is claimed for concrete sewers that their interior presents a more uniform wearing surface and that they are not so apt to crumble and eventually cave in. Instead of being composed of many parts, a concrete sewer is a solid mass, impervious to the attacks of moisture and presenting no weak spots.

The Charles street sewer now ends eighty-five feet from the river and its discharge reaches the surface of the water over the masonry which remains of the old sewer that caved in several years ago, entailing a heavy loss upon the city. This lies under the right-of way of the Burlington and that road will bear one-half of the cost of the extension. If the entire sum set aside is not required, the residue will be shared equally by the city and the Burlington, in accordance with the terms of an agreement reached several months ago.

Work is to be commenced as soon as the fortunate bidder can secure the necessary piling, and the contract will specify that the sewer must be completed within sixty days. In future, concrete will probably be used for building all main sewers, as experience in Eastern cities has proven that it is preferable to any other material.

TEN NEW BUILDINGS.

The Hecla Cement & Coal Company's Portland cement plant will consist of ten buildings, as follows: Stock House, 300 x 80 ft.; Kiln House, 187 x 100 ft.; Clinker Mill, 187 x 50 ft.; Power House, 104 x 100 ft.; Machine Shop, 100 x 60 ft.; Cooperage Storage House, 100 x 60 ft.; Cooper Shop, 80 x 60 ft.; Packing House, 80 x 60 ft.; Fuel Mill, 80 x 48 ft. The walls will be of concrete, 30 ft. high, carrying structural steel frame for the roofs. The plant is to have a capacity of 1,000 barrels per day. The plans call for three additional plants of like capacity to be erected in the future. The Indiana Bridge Co. of Muncie, Ind., has the contract for the buildings. The works will be located just outside the corporate limits of Bay City, Mich. Excavations for the foundations are now under way. This part of the work is to be completed within 75 days from September 3, when the contract was let.

Mr. Aman Moore, formerly with the Buckeye Portland Cement Company of Bellefontaine, Ohio, is one of the incorporators of a Portland cement company of Portland, Colorado, recently organized.

AUSTRIA'S GREAT CANAL SYSTEM.

Austria has just adopted a measure for a system of canals that is of far-reaching importance. This undertaking will do more than anything yet enacted in this monarchy to promote the commerce of that country. It will not only bring the various provinces into closer touch, but will also afford the cheapest freight connections with Germany and Russia.

The measure provides for (1) a canal from the Danube to the River Oder; (2) a canal from the Danube to the Moldau, near Budweis, in connection with the canalization of the Moldau from Budweis to Prague; (3) a canal from the Danube-Oder Canal to the Upper Elbe, in addition to the canalization of the intervening Elbe bed as far as Melnik; (4) a canal from the Danube-Oder Canal to the Vistula, and to some navigable portion of the Dniester.

These 992 to 1,054 miles of navigable water ways are to be constructed by the state, with the co-operation of the provinces, districts, and towns, and in particular the cities of Vienna and Prague, which are to furnish proportionate contributions. To guarantee the contributions, the government is to begin immediate negotiations with the interested provincial representatves and with the municipalities of Vienna and Prague. It may be mentioned that the contributions can be made either by single payment or in annual installments, or through the erection of certain portions of the designed work—such as harbors, docks and streets leading to them—or through the cession of land or relinquishment of other property rights and of rights to water ways to which those concerned might otherwise be entitled by existing laws.

The work of construction must begin, at latest, some time during the year 1904. The necessary preliminary work must be so calculated that the whole system will be finished within twenty years. The cost of construction, in so far as this cost has not already been covered through the contributions of the various interested sections, is to be met by an issue of 4 per cent, tax free, government bonds, redeemable within 90 years. The government is empowered to issued these bonds to an amount not to exceed 250,000,000 crowns ($50,750,000) during the period of construction, from the year 1904 to the end of 1912, and the money thus raised shall be used only in building the designated water ways. For the expenses of construction, after the year 1912, the necessary legislative measures will be taken later.

The government is authorized to determine finally the exact routes for the canals in question. Any deviation from the conditions of the programme already fixed by law, or for any enlargement beyond the limits of the prescribed plans, will require especial legislative approval. All matters connected with the execution of the canal project shall fall within the jurisdiction of the ministry of commerce, which is intrusted with the carrying out of the work. The entire cost of construction is estimated at 750,000,000 crowns ($152,150,000). The canals are designed to admit boats up to 600 tons burden.

It will be seen from this really great scheme that the Austrian government is making energetic efforts for the building up of her commerce. Although the topographical configuration will render the work of construction difficult and the severe winters will close the canals for a considerable time each year, the system will be of incalcuable benefit to the whole country and will connect Austria more closely with her neighbors —Germany and Russia. Not only will the cost of freight from the German seaports be appreciably less, but many portions of the interior now practically inaccessible to extensive trade can then be successfully developed. Coal, lumber, and other products, which in certain remote districts cannot be utilized on account of cost of transportation, may then be brought into the market. It is to be hoped that with the completion of these waterways our American products can be more cheaply introduced into Austria-Hungary than at present.

FINISHED ROCK SECTION OF THE CHICAGO DRAINAGE CANAL.

The Springfield Mining, Oil, Asphalt & Gas Co., owning five acres of asphalt land in the Eastern part of Barton county, Md., has sunk a shaft 40 feet deep through solid asphalt. This shaft is to go down 600 feet, under the present contract.

AMERICAN RAILWAY STATISTICS.

The number of passengers carried during the year ending June 30, 1900, as shown by the annual reports of railways, was 576,865,230, showing an increase for the year of 53,688,722. The number of passengers carried one mile—that is, passenger mileage—was 16,039,007,217, there being an increase in this item of 1,447,679,604. There was an increase in the density of passenger traffic, as the number of passengers carried one mile, per mile of line in 1900, was 83,295, and in 1899, 77,821.

The number of tons of freight carried during the year was 1,101,680,238, an increase of 141,916,655 being shown. The number of tons of freight carried one mile—that is, ton mileage—was 141,599,157,270. The increase in the number of tons carried one mile was 17,931,900,117. The number of tons carried one mile per mile of line was 735,366. These figures show an increase in the density of freight traffic of 75,801 tons carried one mile per mile of line.

The average revenue per passenger per mile for the year ending June 30, 1900, was 2.003 cents. For the preceding year it was 1.925 cents. The revenue per ton of freight per mile was 0.729 cent, while for 1899 it was 0.724 cent. An increase in earnings per train mile appears for both passenger and freight trains. The average cost of running a train one mile increased nearly 9 cents as compared with 1899. The percentage of operating expenses to earnings shows a small decrease as compared with the preceding year.

The amount of railway capital outstanding June 30, 1900, was $11,491,034,960. This amount assigned to a mileage basis represents a capitalization of $61,490 per mile of line. Of this amount $5,845,579,593 existed in the form of stock, of which $4,522,291,838 was common stock and $1,323,288,755 preferred stock. The amount which existed in the form of funded debt was $5,645,455,367. This amount was classified as mortgage bonds, $4,900,626,823; miscellaneous obligations, $464,983,341; income bonds, $219,536,883; and equipment trust obligations, $60,308,320. The amount of current liabilities, not included in the foregoing capital statement, was $594,787,870, or $3,183 per mile of line.

The amount of capital stock paying no dividend was $3,176,609,698, or 54.34 per cent of the total amount outstanding. The amount of funded debt, excluding equipment trust obligations, which paid no interest, was $378,937,806. Of the stock paying dividends, 10.18 per cent of the total amount outstanding paid from 1 to 4 per cent; 14.56 per cent paid from 4 to 5 per cent; 6.93 per cent paid from 5 to 6 per cent; 4.29 per cent paid from 6 to 7 per cent; and 6.40 per cent paid from 7 to 8 per cent. The amount of dividends declared during the year was $139,597,972, which would be produced by an average rate of 5.23 per cent on the stock on which some dividend was declared. The amount of mortgage bonds paying no interest was $266,874,623, or 5.44 per cent; of miscellaneous obligations, $16,779,175, or 3.61 per cent; of income bonds, $95,284,008, or 43.40 per cent.

THE PORTLAND CEMENT INDUSTRY.

The following is taken from the advance sheet of the Michigan Bureau of Labor, Scott Griswold, commissioner:

"At the present time there are ten plants completed, eight of which are running day and night, turning out over 6,000 barrels of the finished product daily. Five other plants are in course of construction, some of which are nearing completion, and locations have been selected for eight more, all of which are contiguous to great deposits of the raw material, and on which the work will be rapidly pushed.

The completed plants in the state are located as follows: The Alpena Portland Cement Co., two miles east of the city of Alpena, Alpena county; the Elk Rapids Portland Cement Co., Elk Rapids; Newaygo Portland Cement Co., Newaygo, Newaygo county; the Coldwater Portland Cement Co., one plant one mile west of the city of Coldwater, and one at the village of Quincy, both in Branch county; the Bronson Portland Cement Co., two miles east of the village of Bronson, in Branch county; the Peerless Portland Cement Co. at the village of Union City, in Branch county; the Peninsula Portland Cement Co., offices in the city of Jackson, plant 13 miles south at the village of Woodstock, in the northwest corner of Lenawee county; the Omega Portland Cement Co., four miles north of the village of Jonesville, in Hillsdale county. There is also a plant operated by the Michigan Alkali Co. at Wyandotte, in Wayne county."

The capital stock of these ten corporations aggregates $7,450,000. The average cost of each plant will be about $465,000 and new improvements and buildings are constantly being added at large expense. The daily capacity of the ten plants aggregates 8,500 barrels of 380 pounds each, or an average for each plant of 850 barrels every twenty-four hours.

MINING AND MINERAL EXPOSITION

The Mining Exposition which is to be held in New York City, at the Grand Central Palace, December 2d to 8th, will be the first presentation of the practical branch of the mineral industry to the financial center of the country. It is now assured of a department not originally planned by its management in exhibits to be made by railroads, mining bureaus and commercial associations of the products of their various mining districts.

Judging from the inquiries received, this will be a most important feature of the exposition and assures an abundance of ores and mineral for exhibition in connection with the machinery, supplies and new inventions of the mineral industries to be exhibited by the leading manufacturers.

The exposition will broadly cover every mineral product of mother earth, and the machines, appliances and processes necessary to produce them for the commercial markets. The minerals include gold, copper, silver, zinc, lead, arsenic, aluminum, platinum, nickel, iron, tin, cobalt, antimony, manganese, chromic iron, petroleum and its products, coal, clay and products, precious stones, mica, asbestos, cement, asphaltum, corundum, emery, graphite, quartz, marble, buhrstone, tripoli, pumice stones, fluorspar, barytes, feldspar, slate, carborundum, grindstones, oilstones, sulphur, iron pyrites, mineral paints, sandstone, phosphate rock, gypsum, salt, limestone, granite, etc. and mineral waters.

The general manager, Allen S. Williams, room 629, Park Row building, New York, states that the Mining Exposition is planned to educate the general public and demonstrate the great importance of the mineral industries, as well as to afford a rendezvous and mart for practical miners, stockholders, engineers, geologists, manufacturers and all who are already financially or sentimentally interested. Provision has been made for companies or associations desiring to hold meetings or conventions during the fifteen days of the exposition.

F. L. Smidth & Co., engineers, 66 Maiden Lane, New York, has secured the contract to furnish all the machinery for grinding the necessary raw materials in the new plant of the Lehigh Portland Co., Allentown, Pa.

The board of directors of the University of Cincinnati ask for bids for cement walks and steps to be laid on the university grounds. Bids open to October 21, 1901. Address University of Cincinnati, Cincinnati, O.

THE LEHIGH PORTLAND CEMENT COMPANY'S NEW INDIANA MILL.

For the past eight months the Lehigh Portland Cement Co.'s agents have been investigating Portland cement materials in the West and have finally selected a location for a plant at Mitchell, Ind., where the company will erect a large mill on a 25 acre tract containing an inexhaustible deposit of oolitic limestone, showing from 97 to 99 per cent carbonate of lime, a deposit of suitable shale land has likewise been secured. The capacity of the plant will be 2,200 barrels per day. The principal buildings will be constructed of monolithic concrete. Work on the plant will be begun at once. The Baltimore & Ohio Southwestern railroad is now laying tracks to the mill site. The Chicago, Indianapolis & Louisville railway will likewise connect with the works. A 1,500 horse power engine will supply power for the plant which is to be lighted by electricity. The entire equipment of the plant will be modern and up to date in every respect. The construction of the plant will be under the supervision of Mr. Charles A. Matcham, general superintendent of the Lehigh Portland Cement Co.'s mills.

J. B. White & Co. have installed 32 rotary Portland cement kilns in their plant in England.

Arthur Chapin & Co. of Bangor, Me., received a cargo of cement on September 18th, coastwise.

WANTED.—The sale of the product of a reliable Portland cement mill. See our advertising colums this issue.

Concrete subways are under construction at Springfield, Mo., on several streets under the railway tracks.

The section of the St. Charles street sewer extension at St. Joseph, Mo., will be constructed of concrete.

The Carbon Stucco Co. of Fort Dodge, Iowa, has decided to join a combine of the stucco mills of that vicinity.

The Buckeye Lime Co. of Genoa, O., is placing a powdered lime upon the market manufactured under a patent process.

Tenders are invited for the construction of $15,000 worth of concrete sidewalks in and for the village of Port Colborne, Ont.

The Wellston Portland Cement Co.'s works at Wellston, O., is now running in first-class order producing over 400 barrels per day.

The Monolith Portland Cement Co. at Bristol, Ind., has been pushing work upon its steam power plant. A 40-horse power boiler being installed.

The Michigan Lime Co. of Grand Rapids, organized with $200,000 capital, filed articles of incorporation with the secretary of state at Lansing.

Steel work for the "wet end" of the Egyptian Cement Co.'s factory is arriving at Fenton, Mich., the shipments having been delayed by the steel strike.

The strike of the building trades of San Francisco has seriously interfered with building construction in a wide range of territory outside of San Francisco.

Mr. A. C. McComb of Oshkosh, Wis., is promoting a Portland cement plant, to be located near Amherst, Portage county, Wis., where extensive marl deposits exist.

The bark Norma, with a cargo of cement from Antwerp, Belgium, discharged 6,200 barrels at Seattle, the remainder of the cargo going to Tacoma for storage.

Freight officials of the Duluth lines report an unusually heavy traffic in cement coming West via the lakes. The traffic indicates big building operations at various points West.

The Iola Portland Cement Co. has sold to the Davenport Water Co. of Davenport, Ia., 6,500 barrels of cement to be used in the new settling basin at pumping station No. 1 now under construction.

The Michigan Portland Cement Company's plant at Quincy has started up, to grind the clinker on hand. Should the condition of the market warrant, the mill will continue to run to fill orders received.

The general sales offices of the Iola Portland Cement Co. have been removed from Chicago to suite 928 Lincoln Trust building, St. Louis, Mo., where all mail matter relating to the sales department should be addressed in the future.

Mr. Harvey Hannaford of S. Hannaford & Sons, architects, of Cincinnati, O., says: "It is only a question of time when steel in large buildings will be supplanted with cement. You would be surprised to know how fully cement answers all the demands made upon steel for girders, floors and floor supports, while in case of fire it is absolutely indestructible, and does not warp under heated extremes. I have used it in a number of buildings, and found it better than steel, stronger and much less expensive. The time will come, no doubt, when buildings made almost entirely out of cement will grace the best built streets of our cities, and when it does a new epoch in the building line and construction ideas will have been marked."

The James River Cement Works, near Glasgow, Va., has made an enlargement of its plant. A new steel kiln has been completed, which doubles the capacity of the plant, the daily output now being 200 barrels.

Work commenced on September 16 breaking ground for the new cement plant of the Farwell Portland Cement Co., at Farwell, Mich., and will be actively pushed to complete the buildings so the output can be placed on the market in the spring. The right of way for the railroad has been secured and the work of grading is expected to begin on the roadbed very shortly. The road will run in a direct line to Littlefield Lake, about six miles south, and the marl transported from there to the plant, which will be located between the Ann Arbor and Pere Marquette railroads in the western part of the town of Farwell.

Stamsen & Blome, the well-known contractors, Unity building, Chicago, report the following more important contracts awarded them during the last 30 days: The concrete work of the Auditorium Annex Hotel, comprising some 130,000 feet of concrete floors, the concrete work of the Brock & Rankin building, the concrete foundations and floors of the Moxley butterine plant, the concrete foundations, floors and sidewalk of the Bullen & Co. 48 drum malthouse, all of Chicago. Also 12,000 feet of combined curb and gutter for the city of Kenawee, Ill., and the concrete fireproof construction and cement floors of the Western Tube Works plant at the same place. The concrete foundations of a large stockhouse for the Gund Brewing Co. at La Crosse, Wis. Also 148,000 feet of cement sidewalks at Birmingham, Ala., and additional contracts for walks at La Porte, Ind., making the total of contracts there 200,000 feet.

MACHINERY WANTED.

I desire to purchase a full set of crushing and pulverizing machinery, viz: Stone Crusher, Ballmill, Tubemill, Conveyors, Steam Engine, Boiler, Automatic Packer, and Scales. The above may be second hand, providing, in very good condition.

CHARLES WILLMS, Jr.,
19 E. Fayette St, Baltimore, Md.

POSITION WANTED!

Young cement chemist; European college graduate, with three years' experience in this country, is open for an engagement. Best of references. Address "C. F." care *Cement and Engineering News*, 162 La Salle Street, Chicago, Ill.

GOLD ORES TREATED.

Gold ores treated in any quantity. Assay value guaranteed. Mines examined, etc.

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DYCKERHOFF PORTLAND CEMENT.

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GOLD MINING PROPERTY FOR SALE.

Gold mining property for sale, located at Das Cabeces, Arizona. Three claims; Fisher vein; good development. Pay streak, 3 ft. wide, 4,500 ft. long, will average $300 per ton and over; ore unlimited; will bond. For particulars address GEO. H. HARTWELL & CO., 303 Dearborn Street, Chicago, Ill.

FOR SALE!

A Two-Rotary Portland Cement Works in Northern Ohio, including three hundred acres marl land. Equipped with the most modern machinery and is in complete running order. Address "OPPORTUNITY," care *Cement and Engineering News.*

FOR SALE!

(OR CAPITAL WANTED TO DEVELOP)

A large tract of Portland Cement Material land along a trunk line railroad, adjacent an extensive and flourishing cement manufactory. Address "NEW SOUTH," care *Cement and Engineering News.*

FOR SALE!

One 60-ft. x 72-in. Rotary Kiln of Bonnot Company, Canton, O., make. In use for about two weeks. In good condition. Will put on cars at Pittsburg for $2,800.00. Address HARBISON-WALKER COMPANY, 1405 Park Bldg., Pittsburg, Pa.

FOR SALE!

One second hand McKelvey Hand Power Concrete Mixer. For particulars, address C. L. CORNWELL, 906 Columbia Building, Louisville, Ky.

MACHINERY WANTED!

The undersigned desires to purchase for the purpose of crushing, grinding, and finally pulverizing Feldspar a complete set of machinery, viz: Engine, Boiler, Smoke-Stack, Stone Crushers, Tubemill, Automatic Packer, etc. The above may be second hand but must be in very good condition. CHARLES WILLMS, Jr.,
No. 19 E. Fayette St., Baltimore, Md,

WANTED!

General Manager to take charge of large Cement Company, whose plant is now in process of construction, in the West. Must have had experience. Prefer Manager now in charge of large works. Will be required to take an interest in the company. Location one of the best in the United States. Excellent opportunity for competent man. Address "CEMENT MANAGER," care *Cement and Engineering News,* 162 La Salle Street, Chicago, Ill.

FOREMAN WANTED!

The Texas Portland Cement and Lime Co. of Dallas, Texas, would like to correspond with a bright, energetic man, capable of handling, as foreman, a 600-bbl. cement plant. He must be thoroughly reliable and capable of handling with rapidity any and all breaks which daily occur in cement mills and cause delays. Good salary to the right man. Non-but partles capable of handling men and machinery as above stated need apply.

Camera For Sale!

"Korona" Camera—5 x 7—double rectilinear lenses; rising and sliding front; swing back; hooded view finder. All in good order; cost $23, including one plate holder. Price $10. Address "CAMERA," care of *Cement and Engineering News,* 162 La Salle Street, Chicago.

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with large acquaintance in building material trade throughout the United States, having customers for more cement than it can manufacture,

Desires to Arrange for Sale of the Product of a Portland Cement Mill

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66-68 BROAD ST., NEW YORK

NARROW GUAGE RAILWAYS
FOR CEMENT WORKS
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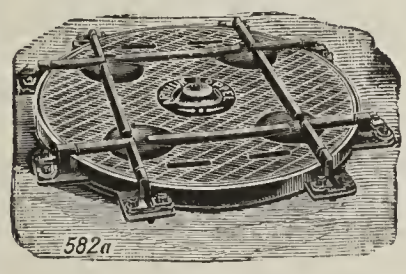

For the complete equipment and rapid handling of all materials used in construction work.

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ALWAYS IN STOCK
SEND FOR COMPLETE CATALOGUE.

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MACHINE-MOLDED SHEAVES, SHAFTING, PULLEYS, FRICTION CLUTCHES.

....FOR HANDLING....

CEMENT LIMESTONE CLAY.

CAST-IRON ENDLESS TROUGH CONVEYOR FOR HOT CEMENT CLINKER.

LINK-BELT MACHINERY COMPANY CHICAGO U.S.A.

PHILADELPHIA
LINK-BELT ENGINEERING CO.

SEND FOR A COPY—"How to Use Portland Cement." The English Translation of the German Portland Cement Manufacturers' Publication. No user of cement should be without a copy of this standard authority. Sent postpaid on receipt of 50 cents. See advertisement.

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Prices Reasonable.

Catalogues Upon Application.

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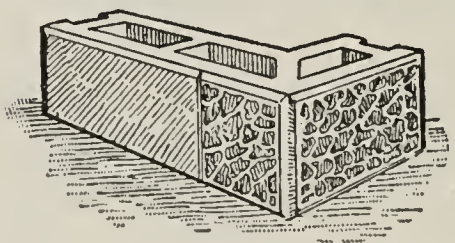
PALMER'S HOLLOW CONCRETE BUILDING BLOCKS



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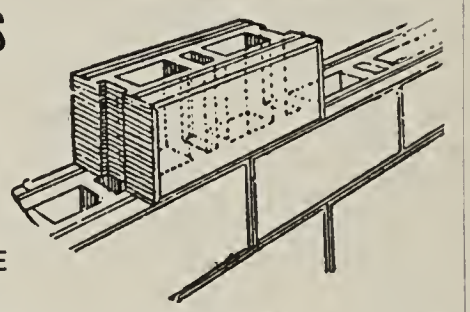

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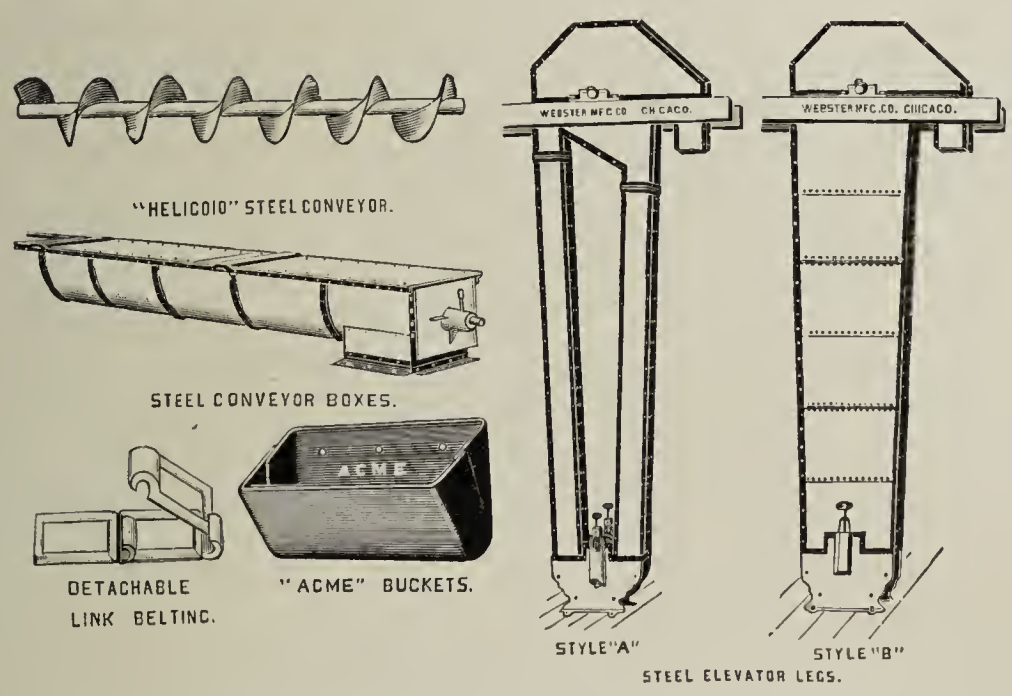

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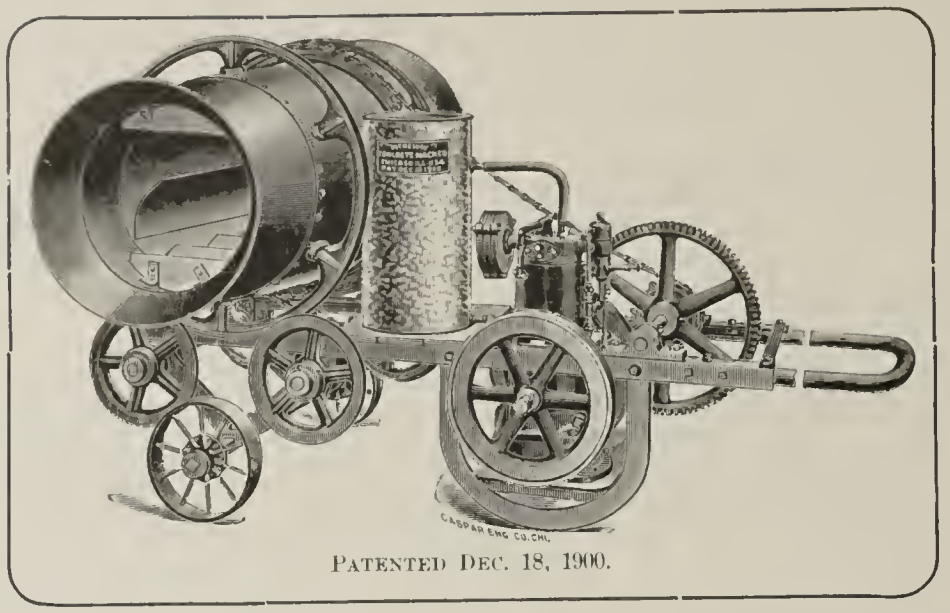

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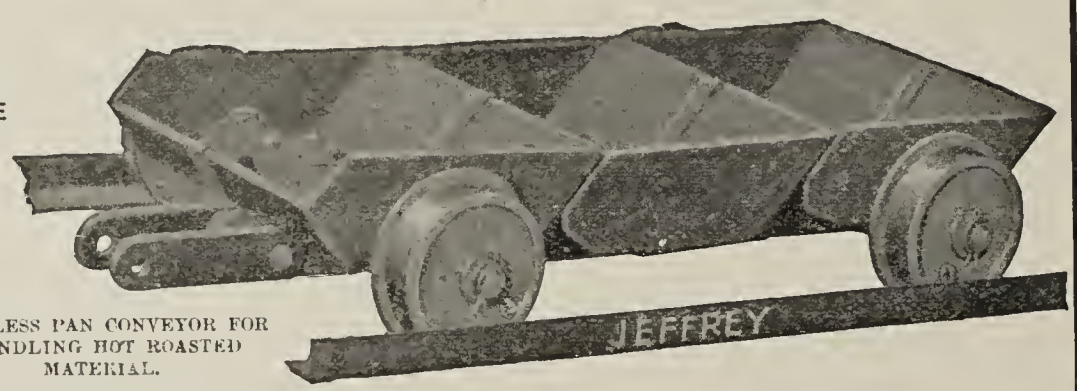

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Mr. Wisner was born at Detroit, Mich., in 1870, and in June, 1892, graduated in Civil Engineering from the University of Michigan. In July he accepted a minor position with the Sanitary District of Chicago, before the actual construction of the canal had been commenced. In September, when the work started, he was employed on the rock section of the canal near Lemont. In 1895 he was transferred to the division of designing in the main office of the engineering staff at Chicago and in September, 1898, was made assistant engineer in charge of Chicago river improvement. The covered concrete by-pass, extending from Monroe to Van Buren street on the West side of the river, was constructed under his supervision. During the present year he was promoted to the position he now occupies.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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CONCRETE SEWER PIPE.

The subject of concrete sewer pipe and sewer construction has not received the attention it deserves from the various municipalities in the United States. While several large cities have adopted this material with extremely satisfactory results, there still exists a strong prejudice against its use, based upon ignorance of its good qualities. People do not like to break away from the old standard of vitrified sewer pipe now in common use. There are several valid causes for this condition of affairs. First, there has been no widespread attempt to direct attention to the good qualities of concrete sewer pipe, fortified by exact data on the subject. Second, there has been no considerable source of supply of concrete sewer pipe available in the past whereby the vitrified glazed sewer pipe manufacturers with few exceptions have held an almost unlimited monopoly for their wares. Third, up to within a few years ago the high price of Portland cement operated against the extensive use of Portland cement concrete specialties. Fourth, the special forms used in the manufacture of concrete sewer pipe are not to be purchased in the open market of the United States.

In England, Germany and France these special concrete sewer pipe forms can be purchased in all sizes for molding concrete forms from 6 to 39 ins. internal diameter. One firm in Germany alone has placed 50,000 of these forms on the market, showing how extensively molded concrete sewer pipe has come into use in that country. There is no substantial reason why this class of sewer pipe should not meet with the same favor in this country. With these forms cities, towns and villages can make their own sewer pipe, superior in quality to the best vitrified pipe and at the same time give employment to a home industry and result in a direct saving to the taxpayer.

The City of Buenos Ayres, Argentine Republic, uses concrete sewer pipe exclusively and has for over twenty years past. The latest data shows that over 20 miles of concrete egg-shaped collecting sewers have been laid in that city from 2 feet 6 inches to 4 feet greatest diameter and 12 miles of round sewer 3 to 7 feet in diameter and 11 miles of main sewers 12 to 14 feet in diameter, all of concrete.

Germany with a smaller population to-day uses more Portland cement than is used in the United States with its larger population. In this country the use of Portland cement in sidewalk construction is very extensive, while in Germany it is not used for sidewalk construction at all. Germany would have no cement to export if it were used for sidewalk construction. We predict that the time is coming when the demand for Portland cement for sewer pipe and sewer construction in the United States will approach in quantity the demand now existing for sidewalk construction. We advise our friends and patrons to import metalic forms for molding concrete sewer pipe, now so widely used in Europe and thereby lay the foundations for a prosperous and remunerative business in the locality in which they reside. We will supply addresses of manufacturers to those desiring to look the matter up.

The vitrified sewer pipe industry is now in the hands of a trust which is exacting high prices. "Nothing risked nothing gained" is an old adage that will apply in this connection.

A portion of the important contract for the electrical equipment of the Pacific Coast Portland Cement Co.'s projected plant at Vancouver, B. C., has been awarded to the Bullock Electric Manufacturing Co. of Cincinnati, O., through its local offices in the St. Paul building. The contract, which is said to be valued at upward of $90,000, calls for three 750-kilowatt generators for general power purposes and some 60 motors, varying in size from 7½ horse-power to 150 horse-power, which are to be utilized for driving various machinery in the plant. The balance of the contract will entail an expenditure of at least $300,000. The offices of the company are at 66 Broadway.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	AUGUST.				EIGHT MONTHS ENDING AUGUST.			
	1900.		1901.		1900.		1901	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	29,892,400	117,154	120,641	460	82,513,563	322,810	1,713,381	6,708
Belgium..	28,072,178	89,117	8,477,395	26,059	198,518,553	582,221	55,778,141	167,021
France	297,621	1,277	1,503,200	6,449	11,125,888	39,318	3,869,922	16,195
Germany.....	60,477,072	213,166	11,321,193	42,017	301,308,812	1,165,425	125,211,383	475,295
All Other Europe ...	4,907,155	15,301	618,128	1,804	20,159,217	60,273	7,012,390	18,783
British North Am...	177,500	879	280,498	873	1,043,450	5,502	1,369,697	6,138
Other Countries.....	1,806,010	7,610	600,800	2,575	15,873,363	30,193	2,417,071	10,283
TOTAL	125,629,936	444,504	22,921,855	80,237	630,542,846	2,205,742	197,371,985	700,423
Domestic Exports of Cements, bbls.	5,149	11,217	34,367	61,559	50,182	109,707	233,525	445,686

There were 18,926,136 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on August 31, 1900, valued at $61,339, against 8,110,671 lbs., valued at $26,640 on July 30, 1901.

Imports of asphaltum or bitumen for August, 1900, were 14,698 tons valued at $49,864; August, 1901—13,953 tons valued at $35,871. For eight months ending August, 1900, 71,086 tons valued at $257,350; for eight months ending August, 1901—97,587 tons valued at $371,378.

CONCRETE WORK FOR THE FARM.

Agricultural papers are beginning to devote considerable space to concrete constructions for farm purposes, such as stable floors, hog pens, chicken houses, feed and watering troughs, for all of which concrete is eminently suitable as well as economical, when the work is properly done. Much of the work described as being done by individual farmers would not pass inspection, inasmuch as barn floors are laid on clay and other undrained foundations. This must be regarded extremely unsatisfactory, since all cement work should rest upon a porous foundation, otherwise the clay or loam is liable to wash out and thus impair the stability of the work. We submit the following specifications, which will result in the production of good reliable work.

Concrete stable floors to be laid on clay or loam, excavate 6 to 8 inches for the foundations, fill in with either cinders, crushed stone or sand, spread in 3-inch layers and tamped well so as to consolidate the material. Foundations should be well flooded and permitted to stand for a week or more, in order that the foundation upon which the concrete is to rest may become thoroughly compacted, smooth off to a level surface.

Next divide the area into sections 3 to 4 feet wide across one side or end where the sections are to be 3 feet wide drive, stakes 3 feet 2 inches from the edge and place 2x4 inch scantlings across the area so as to define one area 3 feet wide by the length of the work. Similar scantlings are to be placed across the area so as to divide the entire space into 3 feet strips or spaces, in order that the work may be laid in alternate sections leaving one space open while the other is filled in. Concrete materials, use only the best Portland cement six measures of broken stone to four of clean sharp sand and one of cement; the sand should first be deposited on a board floor or mixing box, which may be 3 feet 4 inches wide by 6 feet long at the top by 5 feet at the bottom. The sand and cement should be well mixed dry by turning over four or five times with shovels. The crushed stone should be wet down and permitted to drain. The mixed cement and sand should next be deposited on the crushed stone and the entire mass again turned over several times and moistened during the process of turning over with shovels. Just sufficient water should be used to moisten the mass and show a slight moisture on the surface when being tamped. The concrete is next loaded into wheelbarrows and deposited into one of the areas enclosed by the scantling and raked to a comparatively even surface and tamped down so as to leave about ½ to ⅔ of an inch below the top of the scantling for the finishing coat or surface. The finishing coat or surface should consist of one part cement to two parts clean sharp gravel forming a cement mortar sufficiently moist to flow easily under the trowel. This finishing mortar should be deposited in place in buckets before the rough concrete has set and in sufficient quantity to build up in the center of the space. It is spread evenly over the space between the parallel scantling by using a 1-inch board with a straight edge and about 3 feet 6 inches long and 4 inches high. This striking-off board spans the space between the scantling and forces the mortar forward so as to evenly spread the same and fill in the entire space. The finishing coat is smoothed down with a wooden float before the cement has set; too much troweling is not desirable as it tends to produce hair clocks by causing the sand in the mortar to separate and leave too rich a cement on the surface, which is not desirable. The concrete should be deposited in place as soon as mixed and not disturbed after it has commenced to set to insure good work and should likewise be kept moist after it has set; it will take water to advantage in 24 hours after the work is completed. Work done in the winter should be covered with horse manure after it has become thoroughly set. This will protect it against frost; a liberal covering of straw will likewise answer for protection against frost.

Floors for hog and sheep pens may be made 2½ inches thick. The thinner the concrete floor the more secure must the foundation be made. For milk house and cellar floors the same methods may be adopted while the concrete may be reduced to 3 inches thick. The same precautions must be observed to secure ample drainage space as well as well compacted foundations upon which the durability of the superstructure of floor depends.

Where the floor space is to be divided into stalls, a ⅜-inch bolt with a washer should be imbedded into the concrete, extending down to within 1 inch of the bottom of the floor and a 4-inch square section of the concrete built up above the general level of the floor with the iron bolt rising up out of the concrete, the bolt being used to fasten the wood work to the floor at the lower end of each stall.

The Bellaire Portland Cement Co. of Bellaire, Mich., organized with $350,000 capital, has filed articles of incorporation at Lansing.

CONCRETE—STEEL CONSTRUCTION.

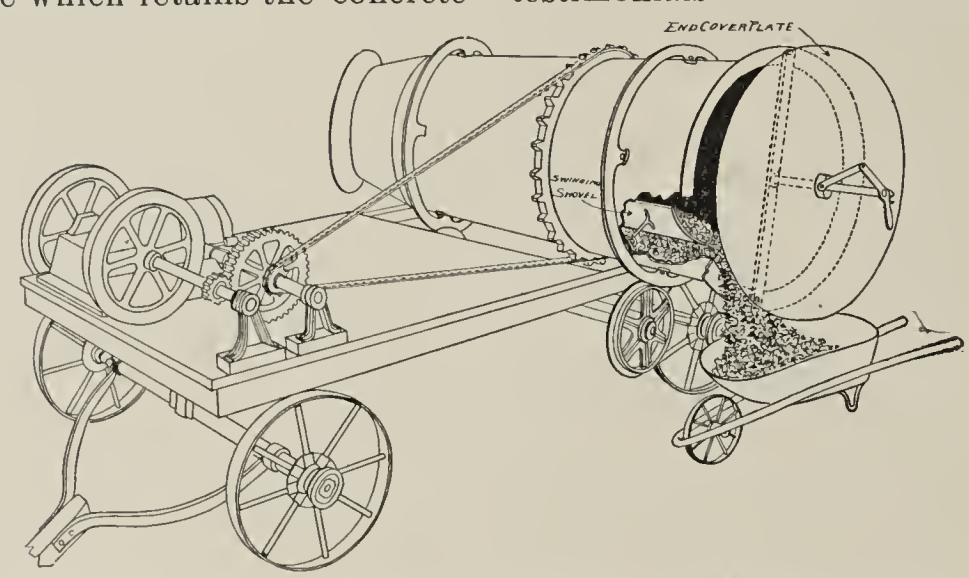
E. Lee Heidenreich, patentee of the new system of covering roofs with armored cement plates made of electrically welded fabric encased in cement mortar according to the Monier system, has closed contracts for covering the buildings of the Illinois Zinc Co. at Peru, Ill., roofs, sides, ends and all. Also with the Illinois Steel Co. for covering the Bessemer mixer building, also the working tower of the cement storage elevator for the same company. We have earlier had occasion to mention the Monier floors built around blast furnaces Nos. 9 and 10 at the Illinois Steel Co.'s South Chicago plant. An accident happened sometime ago to blast furnace No. 9, whereby the construction beneath the casting floor was subjected to a tremendous heat from a stream of molten metal, destroying all brick and tile enclosure. It was found that the Monier floors alone remained absolutely intact, and Mr. Heidenreich at once received an order for covering all the cast iron columns around blast furnace No. 10 with armored mortar. The construction of the elevator for storage of cement at South works is progressing rapidly. It consists of five cluster tanks according to the Heidenreich patent and resting on a series of columns 12 feet high. The tanks are 25 feet in diameter and 50 feet high. Considering the fact that cement weighs nearly twice as much as water, the construction would be able to carry water of nearly 100 feet hydrostatic pressure. In other words tanks 100 feet high filled with water.

The seven (7) tanks which were built at New Orleans at the Illinois Central Railway Co.'s elevator are now finished and water tight.

The Northwestern Tile Co., contractors for concrete construction, Milwaukee, Wis., have been awarded several large contracts within the past month. A new store building for Krœger Bros. Co., Milwaukee, 80,000 square feet floors, together with fire-proofing of entire building. Foundations for new Grand avenue bridge, Milwaukee, 60,000 cubic feet. A concrete and steel bridge, Milwaukee. Cement floors in new stockhouse for Blatz Brewing Co., 40,000 cubic feet. They have just completed 10,000 feet of curb and gutter in Waukesha, Wis., and a like amount in Racine, Wis. Seven large coke storage bins for the Milwaukee Gas Light Co. Foundations and 65,000 square feet cement floors for Norberg Mfg. Co.'s new machine shop. 10,000 feet of curb and gutter now in course of construction at Janesville, Wis., besides a number of smaller contracts.

McKELVEY'S COMBINATION BATCH AND CONTINUOUS CONCRETE MIXER.

The McKelvey Concrete Machinery Co. has added a new feature to its concrete mixers, whereby they can be used for batch as well as continuous mixing. The new attachment is designed to meet the requirement of the most exacting specifications which require the concrete to be turned over in the drum a certain number of times; to accomplish this end the new machine is unique. An end-closing disk covers the discharge end of the drum, which can be opened and closed at will by operating a hand lever. The men wheeling away the concrete place the barrow in position to receive the concrete and pull the lever and the end opens, as shown in the illustration. The moment the barrow has received its quantity of concrete the barrow man operates the lever and thus closes the end plate which retains the concrete in the drum until the next barrow is ready to receive its charge. This is repeated continuously, while the the drum is in motion mixing the concrete, there being no stopping in feeding into the drum or in discharging it into barrows.



The concrete is mixed in a horizontal rotating drum mounted on ball bearing wheels. The interior of the mixing drum has a series of deflecting blades riveted transversely to the inner surface of its shell which cause the materials to advance automatically through the drum from the feed end to the discharge end, while rocking shovels extending lengthwise through the drum collect and lift the material and repeatedly turn it over during each full revolution of the drum. As the material advances from the feed end towards the discharge end, the operation of the rocking shovels on the concrete is almost identical with that of men turning and mixing concrete with shovels only more thorough and much oftener, whereby the most perfect mixing attainable is accomplished, while the output is increased many fold with the least possible expenditure of labor. These machines can readily be moved from place to place on the work by hand so that the concrete can always be mixed at the exact point where wanted as the work progresses. At no time during the mixing process are the materials held together and elevated in a compact form as a dead inert mass cohering together through a greater or less portion of each revolution. On the contrary there is always a relative motion between each of the particles constituting the mass whereby there is no waste power applied in operating this machine. This mixer will pay for itself several times in a single season for any class of work where any considerable quantity of concrete is to be used, as has been repeatedly demonstrated on railway work, sidewalk work and by general contractors using these mixers in various parts of the United States, Canada and Europe. For circular testimonials and other information address the McKelvey Concrete Machinery Co., 1206 Security building, Chicago, Ill.

The French courts have fixed the responsibility for the failure of the steel and concrete foot bridge outside of the Paris exposition grounds leading to the Celestial Globe Co.'s exhibit which resulted in the death of eight persons. The court found that the columns supporting the girders were too weak to sustain the load and as well as the changing of the distribution of the columns as originally planned to save certain trees which were in the way. A fine of 600 francs was imposed on the designer and consulting engineer. Mr. Von Emperger of Vienna, owner of the Melan arch and bridge patents, in commenting on this accident, says experience proves that while a beam encased at both ends is stronger than one not so encased, this gain is entirely due to the character and strength of the walls or piers supporting the beam. If these cannot endure the stresses which the beam throws upon them, then the latter can carry no more load than a beam not encased.

HIGH-SPEED ELECTRIC TRACTION.

A German company was organized in October, 1899, for the purpose of making experiments in high-speed electric traction from 125 to 150 miles per hour—under the name of "Studien Gesellschaft" of which Dr. Schulz, chief of the Imperial German railway, is president. Messrs. Siemens & Halske and the General Electric Co., together with several large machine builders and banks are interested. $178,000 has been contributed to carry out the experiments. The Siemens & Halske Co. and the General Electric Co. of Berlin have each built motors to be used in the trials for high speed. The German Emperor has sanctioned the enterprise and has placed 18.6 miles of military roadbed extending from Berlin to Zassen at the disposal of the association which is to carry out the tests. These tests are to take place during the present month of October, when two motor cars with 50 passengers will be carried over the road designated at a speed of from 125 to 150 miles an hour if possible. Preliminary tests made over a short line of road owned by the Siemens & Halske Co. from Berlin to Sichlenfelde indicate that no serious unsurmountable obstacles are expected in the trials over the line from Berlin to Zassen.

MICHIGAN CEMENT TROUBLES.

A meeting of the bondholders of the Michigan Cement Co., called by Milo D. Campbell, John Duncan, W. E. Parnell and Charles Briggs, was held at the Hotel Cadillac, October 8th. The Holmes interests were represented by H. H. Hatch. There were about 50 people present. The Holmes reorganization proposition, which involves the surrender of the bonds and mortgage, was voted down, as was also the foreclosure proposition of Milo D. Campbell.

After some hours of argument, the meeting adjourned after appointing a committee consisting of D. C. Roxford, Alfred Milnes, J. W. Helme, Charles Briggs and D. C. Griffen, instructed to look over the situation and report at the annual meeting at Coldwater, November 29th. This committee was not satisfactory to Mr. Campbell and others. He called a meeting in his room immediately after adjournment, concerning which he afterward said that a majority of the bonds were represented, and a committee was appointed consisting of himself, Mr. Helme and A. B. Culver of Albion, to consider the advisability of foreclosure, and also any propositions for settling the difficulties of the company.—*Detroit News.*

AMERICAN CEMENT.

By Ernest R. Ackerman,
President Lawrence Cement Company.

The manufacture of Portland cement in this country has increased enormously during Mr. McKinley's administration. It was one of the industries in which he took especial interest, and in his closing remarks upon the McKinley bill he devoted a considerable portion of his time to an exposition of the industry.

In 1897 there was produced in the United States 2,677,000 barrels of Portland cement, while this year the production will exceed ten millions of barrels.

Formerly, imported cement was used in the foundations and in the construction of all important public buildings. However, as we are now supplying the Dragon Portland cement for the new custom house, stock exchange, chamber of commerce and the East River bridge, it may be safely assumed that American Portland cement has gained a foothold with engineers and architects that the foreign can never displace.

EXPERTS ON LAND AND LAKE ASPHALT.

An article in *Municipal Engineering* digests the replies received by Mayor Rose of Milwaukee, in response to inquiries sent to various cities as to the respective merits of land and lake asphalts. Twelve replies were received; five of them were to the effect that land asphalt was barred and in a few other cities no satisfactory tests of comparative merit had been made, but, nevertheless, much light was thrown on the controversy by the replies from experts in other cities. The city engineer of Joliet, Ill., says that the quality of an asphalt pavement is independent of the source of the asphalt, but depends entirely on the proper mixing of the asphaltic cement and the presence of asphaltine and bitumen in the proper proportions. The city engineer of Albany, N. Y., says that there is no doubt that land asphalt, properly mixed, is as good as pitch lake asphalt, besides being considerably cheaper than the trust product. He based his conclusions on a series of experiments extending over several years. In Boston there has been no comparative test made, but the city has recently begun the laying of land asphalt on account of the lower price, and Washington is doing the same. Buffalo and Cleveland use both brands, and the city engineer of New Orleans, "after experiments and a close study of the subject for five years," says that he can see no difference in quality.

From the replies it would seem that the conclusion is warranted that land asphalt is as good as any other asphalt. It all depends on the components of the material and the manner of mixing. If an asphalt from any source whatever contains the elements which are essential to the making of what experience has shown to be the most serviceable asphaltic cement, then that is a good asphalt, provided it is properly refined and mixed.

GERMAN CEMENT EXPORTS.

Germany's exports of Portland cement have considerably increased during the last few years; even in 1900, notwithstanding the unfavorable business situation, a further increase has been noted. In 1894, the exports of Portland cement from Germany amounted to 362,000,000 kilograms (796,400,000 pounds); in 1900, to 543,990,000 kilograms (1,196,778,000 pounds), or 15,315,000 kilograms (33,693,000 pounds) more than in 1899.

From Stettin, the exports of Portland cement have decreased; these amounted to 80,632,000 kilograms (177,390,400 pounds) in 1900, against 88,689,000 kilograms (195,115,800 pounds) in 1899. On the other hand, Hamburg has taken the leading place, and trade has further developed in 1900, although the increase was not so considerable as in the preceding year. In 1900, the exports of Portland cement from Hamburg amounted to 306,571,800 kilograms (674,457,960 pounds), valued at about $3,000,000; in 1899, to 293,483,900 kilograms (645,664,580 pounds), valued at about $2,950,000.

The principal country importing it from Hamburg is the United States, which alone took 115,381,400 kilograms (253,839,080 pounds); however, in previous years, the exports thither have been more considerable. The reason of this retrogression is the development of home industry in the United States, which has caused several cement factories located in the vicinity of Hamburg to open branches in the United States.

After the United States come Australia, with 32,100,000 kilograms (70,620,000 pounds); Brazil with 19,300,000 kilograms (42,460,000 pounds); and Cape Colony, with 17,200,000 kilograms (37,840,000 pounds). Since 1896, the exports to Cape Colony have been quintupled. Among other countries importing Portland cement may be mentioned the Argentine Republic, Chile and British North America. The chief exports to European countries were made to Great Britain, Norway, Spain and Portugal.

The exports of Portland cement via Bremen showed a slight decrease last year, amounting to 49,123,400 kilograms (108,071,480 pounds), compared with 52,332,400 kilograms (115,131,280 pounds) in 1899.

A PROPOSED 165-FOOT CONCRETE THREE-HINGED ARCH BRIDGE NEAR OVIEDO, SPAIN.

It is proposed to build a concrete arch bridge, of 165-foot span, over the River Nalon, in Spain, near the city of Oviedo. The structure will be the largest masonry arch in Spain, and will be hinged at the crown and springing points.

The arch is segmental in form, 165-foot span and 18 feet 9 inches rise, from the center of the crown-hinge to center of the springing-line hinge. At these two points the depth of the arch will be the same, or 3 feet 7 inches; but midway between these points the depth will be 4 feet 8 inches. At the right abutment the rock will be cut away so as to form a surface perpendicular to the axis of the arch, and on this will be fixed the lower hinge. For the left abutment a foundation will be provided by digging down to a depth where the resisting power of the subsoil will withstand a maximum pressure of $3\frac{1}{2}$ tons to the square foot.

To provide for flood water, two discharge arches, each 8 feet 3 inches wide, will be built in one of the approaches. These openings will also be built of concrete, but they will be faced with ashlar masonry. The main arch is to be faced with brickwork, and it will carry spandrel arches—of 5-foot span—supporting the roadway, which latter will be 17 feet wide between the inside of the parapet walls. No provision is made for separate footways, and the parapet is open cast-iron work. The spandrel arches and piers are faced with stonework, like most of the exposed parts of the structure.

The hinge is virtually an upper and lower shoe and a central pin, all of steel, 2 feet 6 inches high, by 3 feet 7 inches long, by 1 foot 7 inches wide, when assembled together. The metal in the shoe-plate is $2\frac{1}{2}$ inches thick, but the diameter of the pin is not stated. Distributing plates will probably be used in transferring the load to the abutments.

The proportions of the concrete, by volume, specified for the arch are, cement 1 part, sand 2.5, and broken stone 5 parts.

H. E. Brown of Coldwater, chemist for the Michigan Portland Cement Co., has been granted a patent on an invention consisting of a process of manufacturing a new and improved "Dolomitic Sandstone." This artificial stone contains principally common sand and when finished closely resembles marble.

OIL FOR HIGHWAYS.

Crude oil is now extensively used for sprinkling streets and highways in California. Experience has demonstrated that oil heated to 180 degrees sprayed over the roads give the most economic results. This system gives a hard smooth surface to the road treated and costs less than water used during the season, one town having reduced expenses from $1,200 to $750. After several sprayings the roadway resembled an asphalt pavement.

At Golden Gate park oil spraying has been tried on asphalt paved driveways in the park with uniform success, resulting in a great saving over water sprinkling. The park commissioners estimate at least a reduction of $500 per month in the use of oil over water.

BANKRUPTCY ACT OF 1898.

The National Association of Credit Men, 20 Nassau street, New York City, is sending out literature to business men which advocates the retention of the present United States bankruptcy act. With the view of building up public sentiment in its favor, special attention is called to the following propositions, which are borne out by statistics and experience. That the bankruptcy law of 1898 has:

1. Put an end to chattel mortgage failures, fake confessions of judgment, and, in general, to the old-time race for the register's office; all now share alike.
2. Made preferences, where creditors are vigilant, rare, if not impossible.
3. Committed the administration of estates to trustees chosen by the creditors rather than by the failing debtor.
4. Increased dividends, and cut down the expenses of administration to a minimum.
5. Made, as a rule, credit more secure, without contracting it.

Repealing the law at this time would mean a return to the old system of state administration. All business men should oppose its repeal.

ELECTRIC LOCOMOTIVES.

The Jeffrey Manufacturing Co. of Columbus, Ohio, has issued a 54-page catalogue which illustrates and describes various types of electric locomotives manufactured by them for mining, mill and other industrial purposes, together with the electrical appliances used in operating installations of electrical Hawlage systems. Te those desiring to install electric Hawlage this catalogue will give much valuable information and guidance. To be had on application.

The New York Central railway has begun the work of facing its retaining walls at Albany, with cement.

TESTING HYDRAULIC CEMENTS.—II.

Report of Major William L. Marshall, Major Smith S. Leach and Capt. Spencer Cosby, Corps of Engineers, U. S. A., being Professional Paper 28 of the Corps.

(CONTINUED FROM SEPTEMBER.)

Classification of tests.—The tests to be made are two classes.

1. Purchase tests on samples furnished by bidders to ascertain whether the bidder may be held on the sample to the delivery of suitable material, should his offer be accepted.

2. Acceptance tests on samples taken at random from deliveries, to ascertain whether the material supplied accords with the purchase sample, or is suitable for the purpose of the work, as stated in the specifications for cement supplies.

1. Purchase tests.—Under these specifications bids for Portland cements will be restricted to brands that have been approved after at least three years' exposure in successful use under similar conditions to those of the proposed work. This specification limits proposals to manufacturers of cements of established repute, and in so far lessens the dependence to be placed upon tests of single samples of cement in determining the probable quality of the cements offered, that sample packages may not be required with the proposals when the brand is known to the purchaser. When the cement is not known to the purchasing officer by previous use, a barrel of it should be required as representing the quality of cement to be supplied. A full set of tests should be made from this sample, and subsequent deliveries be required to show quality at least equal to the sample.

In this connection it is advisable in districts where well equipped laboratories have been established, that sample packages of the cements in use in that territory, as sold in the open market, be obtained and tested as occasion offers, to ascertain the characteristic qualities of the brands as commercial articles, the information to be used in subsequent purchases of cements.

When purchase samples are waived, acceptance tests should be based upon the known qualities of the brand, as shown by previous tests.

The sample barrel should not be broken further than to take therefrom the necessary samples for testing. Afterward it should be put away in a dry place and kept for further testing, should the results obtained be disputed.

2. Acceptance tests.—The tests to be made on cements delivered under contract depend not only on the extent, character and importance of the work itself, but also on the time available between the delivery and the actual use of the material.

(a) On very important and extensive works, equipped with a testing laboratory and adequate storehouses, where cement may be kept at least 30 days before being required for use, full and elaborate tests should be made, keeping in view the fact that careful tests of few samples are more valuable than hurried tests of many samples.

(b) On active works of ordinary character, when time will not permit full tests, and on small works where the expenses of a laboratory are not justified, the tests must necessarily be limited to such reasonable precautions against the acceptance and use of unfit material as may be taken in the usually short interval between the receipt and use of the material.

Such conditions were in view in formulating the specification that proposals will be received from manufacturers of such cements only as have been proved by at least three years' use under similar conditions of exposure. Of the tests named in the specifications those for fineness, activity or hydraulicity, specific gravity, weight of packages, and accelerated tests for indications as to soundness may be made within two days after the receipt of the material and with a very small outlay for instruments.

Cement of established repute, shown by specific gravity and fineness to be properly burnt and ground, or normal for the brand, that will set hard in reasonable time, the cakes snapping with a clean fracture when broken between the fingers, and standing the tests above named, may be accepted and used with reasonable certainty of success. Nevertheless, packages taken at random from the deliveries should occasionally be set aside and samples taken therefrom sent to a testing laboratory for the more elaborate tests for tensile strength (and for soundness should the boiling tests not be conclusive). The final acceptance and payment for such cement as may not have been actually placed in the work should, by agreement, be made to depend upon such tests.

In all cases where cement has been long stored it should be carefully tested before use, to ascertain whether it has deteriorated in strength.

Should the simple tests give unsatisfactory or suspicious results, then a full series of tests should be carefully made.

When Portland cement is in question the specific gravity and fineness tests should be made to guard against adulteration, and in all cases test weighings should be made to guard against short weights.

In cases where the amount of cement or the importance of the work

will not justify the purchase of the simple apparatus required for the specific gravity, fineness, and boiling tests, the cement can be accepted on the informal tests mentioned herein, which require no apparatus whatever, but in such cases cements well known to the purchaser by previous use should be selected, and purchased directly from the manufacturer or his selling agent in order that responsibility for the cement may be fixed.

Certified tests by professional inspectors, made as prescribed herein on samples taken from the cement to be shipped to the work, in a manner analogous to that customary among engineers in the purchase of structural steel and iron, may be required in such cases.

Sampling.—The entire package from parts of which tests are to be made is to be regarded as the sample tested. It should be marked with a distinctive mark that must also be appled to any part tested. The package should be set aside and protected against deterioration until all results from tests made from it are reached and accepted by both parties to the contract for supplies.

Cement drawn from several sample packages should not be mixed or mingled, but the individuality of each sample package should be preserved.

In testing it should be borne in mind that a few tests from any sample, carefully made, are more valuable than many made with less care.

The amount of material to be taken for formal tests is indicated herein where weights of the constituents of four briquettes are given, to which should be added the amount necessary for the tests for specific gravity, activity and soundness.

In extended tests the material should be taken from the sample package from the heads and center of barrel, and from the ends and center of bag, by such an instrument as is used by inspectors of flour. All material taken from the same sample package may be thoroughly mixed or mingled, and the tests be made therefrom as showing the true character of the contents of the sample package.

In making formal tests at the work for acceptance of cement sample packages should be taken at random from among sound packages. The number taken must depend upon the importance and character of the work, the available time and the capacity of the permanent laboratory force. For tensile strength the tests with sand are considered the more important and should always be made. Tests neat should be made if time permits.

It is not necessary in any case on a large work to test more than 10 per cent of the deliveries, even of doubtful cement, and a much less number of samples may be taken should no cause for distrust be revealed by the tests made. In very important work of small extent each package may be tested. A cement should be rejected if the samples show dangerous variation in quality or lack of care in manufacture and resulting lack of uniformity in the product, without regard to the proportion of failures among samples tested.

In all cases in the use of cements the informal or simple tests of the character named herein should be constantly carried on. These constitute most valuable tests. Whenever any faulty material is indicated by such tests, elaborate tests should be at once instituted and should the fault be confirmed, the cement delivered and not used should be rejected and the use of the brand be discontinued.

Tests for weight.—From time to time packages should be weighed in gross and afterward the weight of neat cement and tare of the packages determined. If short weight of neat cement is indicated, a sufficient number of packages should be weighed and the average net weight per package ascertained with sufficient certainty to afford a satisfactory basis of settlement.

Records.—For tests at professional laboratories no general requirements as to records seem to be necessary. Each laboratory has its own blanks with certificate, and if a copy of the specifications be sent with the samples, the record returned should be sufficient. For records of formal tests on the work, or in a district laboratory, blank forms should be used. It is desirable to have the specification requirements stated on the form. Notations should be adopted to show for each test that the cement passed or failed, or that the test was not made. No inference should be drawn from the lack of any entry other than that the recorder has neglected his duty.

Silica cement or sand cement.—This is a patented article manufactured by grinding together silica or clean sand with Portland cement, by which process the original cementing material is made extremely fine and its capacity to cover surfaces of concrete aggregates is much increased. The sand is an adulteration, but on account of the extreme fineness of the product it serves to make mortar or concrete containing a given proportion of pure cement much more dense, the fine material being increased in volume.

The increase in cementing capacity due to the fine grinding of the cement constituent offsets, in great degree, the effects of the sand adulteration, so that sand cement made from equal weights of cement and sand approximates in tensile strength to the neat cement and the material is sold as cement.

The extreme fine grinding also improves cement that contains expansives, but nevertheless sand cement should not be purchased in the market, but should be made on the work from approved materials, if used for other purposes than for grouting, for which it is peculiarly adapted.

Whether this material should be used in important works for mortar and concrete, the board considers a question of cost and expediency.

Over against the saving in cement may be placed the royalty on a patented article, the cost of the plant and of manufacture, the inconvenience of attaching a manufacturing establishment to a work under construction, and other elements bearing not only on first cost of cementing material but also involving the element of time. When cement is high priced, means of transportation limited, labor, sand and concrete materials cheap and abundant, the conditions may justify the use of sand cement on economic grounds. In any case, the cement from which the product is made should be tested precisely as other cements.

Slag cement.—This term is applied to cement made by intimately mixing by grinding together granulated blast-furnace slag of a certain quality and slaked lime, without calcination subsequent to the mixing. This is the only cement of the puzzolan class to be found in our markets (often branded as Portland), and as true Portland cement is now made having slag for its hydraulic base, the term "slag cement" should be dropped and the generic term puzzolan be used in advertisements and specifications for such cements.

Puzzolan cement made from slag is characterized physically by its light lilac color; the absence of grit attending fine grinding and the extreme subdivision of its slaked lime element; its low specific gravity (2.6 to 2.8) compared with Portland (3 to 3.5); and by the intense bluish green color in the fresh fracture after long submersion in water, due to the presence of sulphides, which color fades after exposure to dry air.

The oxidation of sulphides in dry air is destructive of puzzolan cement mortars and concretes so exposed. Puzzolan is usually very finely ground, and when not treated with soda sets more slowly than with Portland. It stands storage well, but cements treated with soda to quicken setting become again very slow set-

ting from the carbonization of the soda (as well as the lime) element after long storage.

Puzzolan cement properly made contains no free or anhydrous lime, does not warp or swell, but is liable to fail from cracking and shrinking (at the surface only) in dry air.

Mortars and concretes made from puzzolan approximate in tensile strength similar mixtures of Portland cement, but their resistance to crushing is less, the ratio of crushing to tensile strength being about 6 or 7 to 1 for puzzolan and 9 or 11 to 1 for Portland. On account of its extreme fine grinding puzzolan often gives nearly as great tensile strength in 3 to 1 mixtures as neat.

Puzzolan permanently assimilates but little water compared with Portland, its lime being already hydrated. It should be used in comparatively dry mixtures well rammed, but while requiring little water for chemical reactions, it requires for permanency in the air constant or continuous moisture.

Proper uses of puzzolan cement.—Puzzolan cement never becomes extremely hard like Portland, but puzzolan mortars and concretes are tougher or less brittle than Portland.

The cement is well adapted for use in sea water, and generally in all positions where constantly exposed to moisture, such as in foundations of buildings, sewers and drains, and underground works generally, and in the interior of heavy masses of masonry or concrete.

It is unfit for use when subjected to mechanical wear, attrition, or blows. It should never be used where it may be exposed for long periods to dry air, even after it has well set. It will turn white and disintegrate, due to the oxidation of its sulphides at the surface under such exposure. Specifications for Portland, natural and puzzolan cement are appended hereto.

SPECIFICATIONS FOR AMERICAN PORTLAND CEMENT.

1. The cement shall be an American Portland, dry and free from lumps. By a Portland cement is meant the product obtained from the heating or calcining up to incipient fusion of intimate mixtures, either natural or artificial, of argillaceous with calcareous substances, the calcined product to contain at least 1.7 times as much of lime, by weight, as of the materials which give the lime its hydraulic properties, and to be finely pulverized after said calcination, and thereafter additions or substitutions for the purpose only of regulating certain properties of technical importance to be allowable to not exceeding 2 per cent of the calcined product.

2. The cement shall be put up in strong, sound barrels well lined with paper, so as to be reasonably protected against moisture, or in stout cloth or canvas sacks. Each package shall be plainly labeled with the name of the brand and of the manufacturer. Any package broken or containing damaged cement may be rejected or accepted as a fractional package, at the option of the United States agent in local charge.

3. Bidders will state the brand of cement which they propose to furnish. The right is reserved to reject a tender for any brand which has not established itself as a high-grade Portland cement and has not for three years or more given satisfaction in use under climatic or other conditions of exposure of at least equal severity to those of the work proposed.

4. Tenders will be received only from manufacturers or their authorized agents.

(The following paragraph will be substituted for paragraphs 3 and 4 above when cement is to be furnished and placed by the contractor:

No cement will be allowed to be used except established brands of high-grade Portland cement which have been made by the same mill and in successful use under similar climatic conditions to those of the proposed work for at least three years.)

5. The average weight per barrel shall not be less than 375 pounds net. Four sacks shall contain one barrel of cement. If the weight, as determined by test weighings, is found to be below 375 pounds per barrel, the cement may be rejected, or, at the option of the engineer officer in charge, the contractor may be required to supply, free of cost to the United States, an additional amount of cement equal to the shortage.

6. Tests may be made of the fineness, specific gravity, soundness, time of setting and tensile strength of the cement.

7. Fineness.—Ninety-two per cent of the cement must pass through a sieve made of No. 40 wire, Stubb's gauge, having 10,000 openings per square inch.

8. Specific gravity.—The specific gravity of the cement, as determined from a sample which has been carefully dried, shall be between 3.10 and 3.25.

9. Soundness.—To test the soundness of the cement, at least two pats of neat cement mixed for five minutes with 20 per cent of water by weight shall be made on glass, each pat about 3 inches in diameter and one-half inch thick at the center, tapering thence to a thin edge. The pats are to be kept under a wet cloth until finally set, when one is to be placed in fresh water for twenty-eight days. The second pat will be placed in water which will be raised to the boiling point for six hours, then allowed to cool. Neither should show distortion or cracks. The boiling test may or may not reject, at the option of the engineer officer in charge.

10. Time of setting.—The cement shall not acquire its initial set in less than forty-five minutes and must have acquired its final set in ten hours.

(The following paragraph will be substituted for the above in case a quick-setting cement is desired:

The cement shall not acquire its initial set in less than twenty nor more than thirty minutes, and must have acquired its final set in not less than forty-five minutes, nor in more than two and one-half hours.)

The pats made to test the soundness may be used in determining the time of setting. The cement is considered to have acquired its initial set when the pat will bear, without being appreciably indented, a wire one-twelfth inch in diameter loaded to weigh one-fourth pound. The final set has been acquired when the pat will bear, without being appreciably indented, a wire one twenty-fourth inch in diameter loaded to weigh 1 pound.

11. Tensile strength.—Briquettes made of neat cement, after being kept in air for twenty-four hours under a wet cloth, and the balance of the time in water, shall develop tensile strength per square inch as follows:

After seven days, 450 pounds; after twenty-eight days, 540 pounds.

Briquettes made of 1 part cement and 3 parts standard sand, by weight, shall develop tensile strength per square inch as follows:

After seven days, 140 pounds; after twenty-eight days, 220 pounds.

(In case quick-setting cement is desired, the following tensile strengths shall be substituted for the above:

Neat briquettes: After seven days, 400 pounds; after twenty-eight days, 180 pounds.)

12. The highest result from each set of briquettes made at any one time is to be considered the governing test. Any cement not showing an increase of strength in the twenty-eight-day tests over the seven-day tests will be rejected.

13. When making briquettes neat cement will be mixed with 20 per cent of water by weight, and sand and cement with 12½ per cent of water by weight. After being thoroughly mixed and worked for five minutes, the cement or mortar will be placed in the briquette mold in

four equal layers, and each layer rammed and compressed by thirty blows of a soft brass or copper rammer three-quarters of an inch in diameter (or seven-tenths of an inch square, with rounded corners), weighing 1 pound. It is to be allowed to drop on the mixture from a height of about half an inch. When the ramming has been completed, the surplus cement shall be struck off and the final layer smoothed with a trowel held almost horizontal and drawn back with sufficient pressure to make its edge follow the surface of the mold.

14. The above are to be considered the minimum requirements. Unless a cement has been recently used on work under this office, bidders will deliver a sample barrel for test before the opening of bids. If this sample shows higher tests than those given above, the average of tests made on subsequent shipments must come up to those found with the sample.

15. A cement may be rejected in case it fails to meet any of the above requirements. An agent of the contractor may be present at the making of the tests, or, in case of the failure of any of them, they may be repeated in his presence. If the contractor so desires, the engineer officer in charge may, if he deem it to the interest of the United States, have any or all of the tests made or repeated at some recognized standard testing laboratory in the manner herein specified. All expenses of such tests to be paid by the contractor. All such tests shall be made on samples furnished by the engineer officer from cement actually delivered to him.

SPECIFICATIONS FOR NATURAL CEMENT.

1. The cement shall be a freshly packed natural or Rosendale, dry, and free from lumps. By natural cement is meant one made by calcining natural rock at a heat below incipient fusion, and grinding the product to powder.

2. The cement shall be put up in strong, sound barrels, well lined with paper so as to be reasonably protected against moisture, or in stout cloth or canvas sacks. Each package shall be plainly labeled with the name of the brand and of the manufacturer. Any package broken or containing damaged cement may be rejected, or accepted as a fractional package, at the option of the United States agent in local charge.

3. Bidders will state the brand of cement which they propose to furnish. The right is reserved to reject a tender for any brand which has not given satisfaction in use under climatic or other conditions of exposure of at least equal severity to those of the work proposed.

4. Tenders will be received only from manufacturers or their authorized agents.

(The following paragraph will be substituted for paragraphs 3 and 4 above when cement is to be furnished and placed by the contractor:

No cement will be allowed to be used except established brands of high-grade natural cement which have been in successful use under similar climatic conditions to those of the proposed work.)

5. The average net weight per barrel shall not be less than 300 pounds. (West of the Allegheny mountains this may be 265 pounds.) . . . sacks of cement shall have the same weight as 1 barrel. If the average net weight, as determined by test weighings, is found to be below 300 pounds (265 pounds) per barrel, the cement may be rejected, or, at the option of the engineer officer in charge, the contractor may be required to supply free of cost to the United States an additional amount of cement equal to the shortage.

6. Tests may be made of the fineness, time of setting, and tensile strength of the cement.

7. Fineness.—At least 80 per cent of the cement must pass through a sieve made of No. 40 wire, Stubb's gauge, having 10,000 openings per square inch.

8. Time of setting.—The cement shall not acquire its initial set in less than twenty minutes and must have acquired its final set in four hours.

9. The time of setting is to be determined from a pat of neat cement mixed for five minutes with 30 per cent of water by weight and kept under a wet cloth until finally set. The cement is considered to have acquired its initial set when the pat will bear, without being appreciably indented, a wire one-twelfth inch in diameter loaded to weigh one-fourth pound. The final set has been acquired when the pat wiil bear, without being appreciably indented, a wire one twenty-fourth inch in diameter loaded to weigh one pound.

10. Tensile strength.—Briquettes made of neat cement shall develop the following tensile strengths per square inch, after having been kept in air for 24 hours under a wet cloth and the balance of the time in water:

At the end of seven days, 90 pounds; at the end of twenty-eight days, 200 pounds.

Briquettes made of one part cement and one part standard sand, by weight, shall develop the following tensile strengths per square inch:

After seven days, 60 pounds; after 28 days 150 pounds.

11. The highest result from each set of briquettes made at any one time is to be considered the governing test. Any cement not showing an increase of strength in the twenty-eight day tests over the seven day tests will be rejected.

12. The neat cement for briquettes shall be mixed with 30 per cent. of water by weight, and the sand and cement with 17 per cent. of water by weight. After being thoroughly mixed and worked for five minutes the cement or mortar is to be placed in the briquette mold in four equal layers, each of which is to be rammed and compressed by thirty blows of a soft brass or copper rammer three-fourths of an inch in diameter (or seven-tenths of an inch square with rounded corners), weighing 1 pound. It is to be allowed to drop on the mixture from a height of about half an inch. Upon the completion of the ramming the surplus cement shall be struck off and the last layer smoothed with a trowel held nearly horizontal and drawn back with sufficient pressure to make its edge follow the surface of the mold.

13. The above are to be considered the minimum requirements. Unless a cement has been recently used on work under this office, bidders will deliver a sample barrel for test before the opening of the bids. Any cement showing by sample higher tests than those given must maintain the average so shown in subsequent deliveries.

14. A cement may be rejected which fails to meet any of the above requirements. An agent of the contractor may be present at the making of the tests, or, in case of the failure of any of them, they may be repeated in his presence. If the contractor so desires, the engineer officer may, if he deems it to the interest of the United States, have any or all of the tests made or repeated at some recognized standard testing laboratory in the manner above specified. All expenses of such tests shall be paid by the contractor, and all such tests shall be made on samples furnished by the engineer officer from cement actually delivered to him.

SPECIFICATIONS FOR PUZZOLAN CEMENT.

1. The cement shall be a puzzolan of uniform quality, finely and freshly ground, dry, and free from lumps, made by grinding together without subsequent calcination granulated blast furnace slag with slaked lime.

2. The cement shall be put up in strong, sound barrels well lined with paper, so as to be reasonably protected against moisture, or in stout cloth or canvas sacks. Each package shall be plainly labeled with the name of the brand and of the manufacturer. Any package broken or containing damaged cement may be rejected, or accepted as a fractional package, at the option of the United States agent in local charge.

3. Bidders will state the brand of cement which they propose to furnish. The right is reserved to reject a tender for any brand which has not given satisfaction in use under climatic or other conditions of exposure of at least equal severity to those of the work proposed, and for any brand from cement works that do not make and test the slag used in the cement.

4. Tenders will be received only from manufacturers or their authorized agents.

(The following paragraph will be substituted for paragraphs 3 and 4 above when cement is to be furnished and placed by the contractor:

No cement will be allowed to be used except established brands of high grade puzzolan cement which have been in successful use under similar climatic conditions to those of the proposed work and which come from cement works that make the slag used in the cement.)

5. The average weight per barrel shall not be less than 330 pounds net. Four sacks shall contain 1 barrel of cement. If the weight as determined by test weighers is found to be below 330 pounds per barrel, the cement may be rejected, or, at the option of the engineering officer in charge, the contractor may be required to supply, free of cost to the United States, an additional amount of cement equal to the shortage.

6. Tests may be made of the fineness, specific gravity, soundness, time of setting and tensile strength of the cement.

7. Fineness.—Ninety-seven per cent of the cement must pass through a sieve made of No. 40 wire, Stubb's gauge, having 10,000 openings per square inch.

8. Specific gravity.—The specific gravity of the cement, as determined from a sample which has been carefully dried, shall be between 2.7 and 2.8.

9. Soundness.—To test the soundness of cement, pats of neat cement mixed for five minutes with 18 per cent of water by weight shall be made on glass, each pat about 3 inches in diameter and one-half inch thick at the center, tapering thence to a thin edge. The pats are to be kept under wet cloths until finally set, when they are to be placed in fresh water. They should not show distortion or cracks at the end of twenty-eight days.

10. Time of setting.—The cement shall not acquire its initial set in less than forty-five minutes and shall acquire its final set in ten hours. The pats made to test the soundness may be used in determining the time of setting. The cement is considered to have acquired its initial set when the pat will bear, without being appreciably indented, a wire one-twelfth inch in diameter, loaded to one-fourth pound weight. The final set has been acquired when the pat will bear, without being appreciably indented, a wire one twenty-fourth inch in diameter loaded to 1 pound weight.

11. Tensile strength.—Briquettes made of neat cement, after being kept in air under a wet cloth for twenty-four hours and the balance of the time in water, shall develop tensile strengths per square inch as follows:

After seven days, 350 pounds; after twenty-eight days, 500 pounds.

Briquettes made of one part cement and three parts standard sand by weight shall develop tensile strength per square inch as follows:

After seven days, 140 pounds; after twenty-eight days, 220 pounds.

12. The highest result from each set of briquettes made at any one time is to be considered the governing test. Any cement not showing an increase of strength in the twenty-eight day tests over the seven day tests will be rejected.

13. When making briquetttes neat cement will be mixed with 18 per cent of water by weight, and sand and cement with 10 per cent of water by weight. After being thoroughly mixed and worked for five minutes the cement or mortar will be placed in the briquette mold in four equal layers and each layer rammed and compressed by thirty blows of a soft brass or copper rammer, three-quarters of an inch in diameter or seven-tenths of an inch square, with rounded corners, weighing 1 pound. It is to be allowed to drop on the mixture from a height of about half an inch. When the ramming has been completed the surplus cement shall be struck off and the final layer smoothed with a trowel held almost horizontal and drawn back with sufficient pressure to make its edge follow the surface of the mold.

14. The above are to be considered the minimum requirements. Unless a cement has been recently used on work under this office, bidders will deliver a sample barrel for test before the opening of bids. If this sample shows higher tests than those given above, the average of tests made on subsequent shipments must come up to those found with the sample.

15. A cement may be rejected in case it fails to meet any of the above requirements. An agent of the contractor may be present at the making of the tests, or, in case of the failure of any of them, they may be repeated in his presence. If the contractor so desires the engineer officer in charge may, if he deems it to the interest of the United States, have any or all of the tests made or repeated at some recognized testing laboratory in the manner herein specified, all expenses of such tests to be paid by the contractor. All such tests shall be made on samples furnished by the engineer officer from cement actually delivered to him.

[THE END.]

Judge Coleman of Birmingham, Ala., has granted a temporary injunction in the suit of John F. Baldwin against the Carolina Portland Cement Co. and the Mayberry Hardware Co. The hearing for a permanent injunction has been set for a later date. Mr. Baldwin alleges that he has a contract for the exclusive sale of a certain brand of cement and that this brand has been sold to the Mayberry Hardware Co. He also alleges that the Portland Co. is about to again sell to the Birmingham concern, thus breaking the contract with him. He seeks to enjoin sales and to recover damages for the breach of contract.

The St. Joseph & Grand Island railway, with 515 miles of roadbed in Missouri, Kansas and Nebraska, has adopted concrete in the place of stone for use in building culverts. Seven culverts are being constructed on the main line of the road near Belvidere. Concrete will be used exclusively by the road in future in work of this kind. Discussing the new material, Chief Engineer Hunt said: "Concrete is cheaper than stone and is also more durable. We shall use it hereafter in constructing culverts. Many eastern roads are adopting it for the same kind of work and it is proving highly satisfactory." This is the material that is to be used in the extension of the Charles street sewer.

For the past week Prof. Carleton Ellis of the Massachusetts Institute of Technology, William O. Webber, a Boston expert, and John C. Combs of Boston have been conducting tests at the kilns of Bryant & Kent at Portland, Me., of a new process of burning lime, which it is asserted will revolutionize the lime burning industry by reducing the price from 50 to 75 per cent. At the conclusion of their work they expressed themselves as satisfied with the results. The new method is known as the "Eldred process," a cheap grade of coal is used, where heretofore wood has been necessary to obtain the best lime. It is said to be a new discovery, by which the volume and temperature of combustion are controlled. A flame of low heat intensity, 30 feet long, is produced by which a cask of lime is made with 30 pounds of coal.

The American Cement Co. has purchased $35,000 of its outstanding bonds, reducing its bonded indebtedness to $930,000.

The McLaughlin Contracting Co. of Kankakee, Ill., has received a contract for 2,000 feet of cement curbing and gutter at Hammond, Ind.

Leonard C. Register is considering the erection of a plant for the manufacture of brick, lime and cement at Trio, Williamsburg county, S. C.

A new cement company, with a capitalization of $300,000, is negotiating with the Toronto, Ont., city council for a ten-acre site for a factory on Ashbridge marsh.

The Michigan Cement Post Co. of Marshall has received an order for 2,000 posts to be used by the new electric line under construction from Detroit to Chicago.

For coloring cement work use only mineral colors and only a sufficient amount to give the desired shades; an excess of coloring matter weakens the bond in the work.

The Virginia Portland Cement Co. of Craigsville, Va., will enlarge the capacity of its works from 600 bbls. to 1,200 bbls. per day, to be completed for the early spring trade.

Fifty-three stone companies of Pennsylvania are forming a combination to be capitalized at $6,000,000. It will include fourteen sandstone and thirty-nine limestone quarries.

The Coplay Cement Manufacturing Co. has declared a semi-annual dividend of 3 per cent on the preferred stock, payable November 1st. Books close October 15 and reopen November 2.

The Johannes Lime & Cement Co. of St. Louis, Mo., has filed record of a decrease in its capital stock from $70,000 to $35,000. The company's assets are $55,000 and its liabilities $11,000.

The Ransome Concrete Co. has sub-let to the Marietta Artificial Stone Co. of Marietta, O., 12,000 square feet of the finished cement work in the Washington county court house.

The Colorado Fuel & Iron Co., of Pueblo, Colo., is after a lease or purchase of three hundred acres of land lying between Florence and the Colorado Portland Cement company's works, six miles east of that city.

Contracts will be let about December 1st for the buildings and grounds of the Louisiana Purchase Exposition, estimated to cost $11,000,000, of which $7,000,000 will be for the buildings and $4,000,000 for the grounds.

The Western Portland Cement Co. of Yankton, S. D., will operate its grinding department throughout the winter.

The Ironton Portland Cement Co. of Ironton, O., was incorporated on September 23, with a capital stock of $110,000.

The Iola Portland Cement Co. has been awarded the contract for thirty carloads of Portland cement to be used by the Walsh Construction Co. at Macon, Mo., in a contract for bridge work and retaining walls awarded them by the C., B. & Q.

Incorporated: Illinois Hydraulic Cement Manufacturing Co., capital $50,000, manufacturing cement. Incorporators: Henry H. Zimmermann, Anton E. Preuss and Amelia L. Zimmermann. The works will be located within the city limits of Utica, Ill.

Incorporated: American Portland Cement Co., Ltd., capital $10,000, has been incorporated by W. J. Kelly, L. A. Jung and F. A. Jung of New Orleans, La., to act as agent for the Alabama Portland Cement Co.'s products and for other building supplies, etc.

The Green River Asphalt Co. is building a storage platform at Bowling Green, Ky., with a capacity of 1,200 or 1,500 tons. They will make this city the distributing point for their asphalt, which will be floated to Bowling Green in barges from their mines near Glenmore.

The plant of the Peerless Portland Cement Co. at Union City has shut down. Work will at once be commenced on remodeling the factory. A number of 70-foot rotary kilns will be installed. The power plant will be increased. The machinery is to be operated by electricity.

Directors of the Syracuse Portland Cement Co. of Syracuse, N. Y., at the recent annual meeting, were elected as follows: E. A. Powell, J. B. Dutcher, H. S. Holden, L. B. Crocker, David H. Burrill, Horace White, Chas. P. Clark, Wing R. Smith and Chas. M. Crouse.

The Helderberg Cement Co. has placed in operation in its power plant at Howe's Cave, N. Y., one of the two 1,200 horse power engines contracted for, and the other one will be installed as soon as the work can be done. This will give it the largest power station outside of electric traction or lighting in this section of the country. The plant now has a capacity of 700 barrels per diem of the finest Portland cement. When the second engine is installed, the possible output will be 1,500 barrels daily. The company is prepared to increase its plant almost indefinitely.

Wickes tunnel on the Montana Central railway, 38 miles north of Butte, Mont., is to be rebuilt with concrete, so as to be similar to the Cascade tunnel. The brick which were placed in the interior have become loosened by the jar of passing trains. The tunnel is 6,350 feet long.

The California Portland Cement Co. has filed notice of an increase of its bonded indebtedness from $80,000 to $200,000. This action was taken at a recent directors' meeting in order to create a fund for the purchase of additional property and the improvement of the company's manufacturing facilities.

The Hecla Cement & Coal Co. of Bay City, Mich., is to manufacture gas and has made a proposition to light Bay City. A franchise for this purpose is now pending in the city council. The same company is considering the erection of a chemical plant to utilize the by-product of its proposed gas works.

The Acme Cement Plaster Co. has made a proposition to the town authorities of Chickasha, Indian Territory, for locating works at that point. The company asks for a bonus of $15,000, five acres of land and exemption of taxation for a period of five years, all of which has been accepted by the authorities.

"How to Become a Good Mechanic" by John Phin, paper cover 5x7¼ inches, 68 pages, New York Industrial Publication Co., New York City. Price 25 cents. The book gives a course of reading to be followed, coupled with practical suggestions as to methods to be followed in order to make the greatest advance in self-improvement.

Incorporated: New England Pipe & Cement Co., with principal office and chief works at Boston, Mass., for the manufacture, purchase and sale of all kinds of pipes and tubes, cement, lime or any other material used in building. Authorized capital stock $100,000. Incorporators: E. R. Kemp, Freeland Jewett, Edward Morrison and Louis Kammner of Boston, Mass., and Charles W. Ellis of Newton, Mass.

The Southern Cement Co., manufacturers of a slag cement at North Birmingham, Ala., claims an output of 400 barrels per day. The capacity of the plant is to be doubled at once. T. M. Bradley the secretary of the company says: "From the very beginning we have found a ready sale for the output and our best customers have been our own Birmingham people. The bulk of our trade is at home and I am glad to state that we have orders for all of our cement."

Work has been begun on the Marksboro cement plant and between forty and fifty workmen are employed. A very large building is being put up which, it is thought, will be under cover before snow flies.

The John Rosenfeld's Sons of San Francisco, closed a deal, October 6, for 140 acres of land four miles from Suisun, Solano Co., Cal., on which a Portland cement factory with a capacity of 1,000 barrels a day will be immediately erected. The price paid for the property was over $19,000. The company will be known as the Eureka Portland Cement Company.

W. J. Dingee, president of the Contra Costa Water Co. of Oakland, Cal., is moving in the matter of establishing a Portland cement mill near Placerville, Cal. William Winsboro, Dingee's representative, and an attorney were in Placerville negotiating with land owners for a right of way for a railroad spur from the Placerville & Sacramento railroad to the proposed factory.

An extensive deposit of sand asphaltum, suitable for paving streets and assaying from 14 to 24 per cent pure asphaltum, has been found a short distance from the Northern Pacific railroad in eastern Montana. The deposit will be developed by its owner, Col. O. P. Chrisholm of Bozeman, and will be shipped and used in paving the streets of Helena, Butte and other Montana cities.

Petroleum and asphalt has been discovered in Montague and Cook counties, Texas. The deposit begins a few miles west of St. Jo, Montague county, and extends west to Muenster, Cook county. Col. W. J. Swain of Austin is on the ground to obtain leases to prospect for oil for an Austin company. The oil has a slight asphalt base and contains little parafine and a minimum amount of sulphur.

A meeting of representatives of cement manufacturing concerns from New York, Ohio, Michigan and Indiana was held in the Cadillac Hotel, Detroit, Mich., October 7, for the purpose of taking action looking toward maintaining the price of cement. Wm. Wright of Chicago, was elected president; L. P. Hall of Ann Arbor, Mich., secretary, and George J. Robinson of Alpena, Mich., treasurer. A committee consisting of John Monahan of Alpena, Mich., J. B. Patterson, Union City, Mich., S. B. Newberry, Sandusky, O., W. W. MacLay, Glens Falls, N. Y., C. F. Wade, Jonesville, Mich., Wm. Wright, Chicago, and W. W. Hawley, Huntingdon, Ind., was appointed to look over the field and report on suitable action.

A meeting of the Helderberg Cement Co. was recently held at its office, 38 State street, Albany, N. Y., when the following directors were elected for the ensuing year: T. Henry Dumary, John W. McNamara, William McEwan, Anthony N. Brady, Robert C. Pruyn, John G. Myers, Frederick W. Kelley, James C. Farrell, Thomas E. Murray, Edward L. Pruyn, Charles H. Ramsey and James B. McEwan. The following were elected inspectors of election: S. J. Haight, E. J. Hussey, L. H. Hendricks.

The J. Stevens Arms & Tool Co. of Chicopee Falls, Mass., who have offered to distribute $500 in cash prizes among the sixty young people sending them the sixty best targets made with Stevens rifles, have decided to extend their contest until October 31st, as October is one of the best months in the year for shooting. Great enthusiasm is manifested among the young people of the country in this contest, and if you have not already entered, this is a good opportunity to try your marksmanship. Stevens rifles are acknowledged superior to all other makes.

Seven stockholders in the White Cliffs Portland Cement & Chalk Co. of Arkansas allege that the value of their stock has been lost to them and ask the judges of the circuit court to declare an accounting of the affairs of the company. The complainants are William J. Kelly, John Kelly, David B. Coulter, Dan H. Ball, Esther Marion, Willard H. Edwards and Ernest Dale Owen, who hold stock in the company aggregating in face value $472,500. In the main the allegations of the bill are that through manipulation of bonds and other indebtedness of the company the value of the stock was destroyed.

There are prospects of the establishment of a cement works at Lime Lake, Wis. John Een of Amherst, who owns the lake, has given an option on it to A. C. McComb of Oshkosh, who claims to represent Chicago and Pittsburg capitalists. The lake covers an area of over seventy acres, the bottom soil being a marl formation containing 51 per cent lime. Adjoining the lake is a large field of clay especially suited to the purpose of making cement. The tract has been examined by the state chemist, who found the marl to be of the most promising character. The source of supply is so extensive that it is estimated that a mill of 1,000 barrels daily capacity would require thirty years to consume the clay at present in sight. The price named in the option is $10,000.—*Ex.*

The Caddo Asphalt Co., operating mines east of Ardmore, I. T., has recently been organized and proposes to go to work at once on a more elaborate scale than ever.

The H. W. Caldwell & Son Co., manufacturers of elevating, conveying and power transmitting machinery, Western avenue, 17th to 18th streets, Chicago, have commenced the erection of a large three-story and basement building as an addition to their present plant. It will be remembered that their present plant is a new one, having been completed in January, 1900, but an increasing business makes it necessary to add to their already extensive facilities. The new building will give them an additional floor space of 45,000 square feet. It will be of mill construction three stories and basement, 70x160 feet, and is designed for use as a warehouse and for the manufacture of the sheet metal specialties which form a part of their regular trade. The addition of this building to their plant will also increase the effective working space of their machine shop and will practically double the capacity of the plant. The building will be completed by the first of the year and the enlarged plant will be in readiness for the coming busy season.

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One second hand McKelvey Hand Power Concrete Mixer. For particulars, address C. L. CORNWELL, 906 Columbia Building, Louisville, Ky.

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The undersigned desires to purchase for the purpose of crushing, grinding, and finally pulverizing Feldspar a complete set of machinery, viz: Engine, Boiler, Smoke-Stack, Stone Crushers, Tubemill, Automatic Packer, etc. The above may be second hand but must be in very good condition. CHARLES WILLMS, Jr., No. 19 E. Fayette St., Baltimore, Md.

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The Texas Portland Cement and Lime Co. of Dallas, Texas, would like to correspond with a bright, energetic man, capable of handling, as foreman, a 600-bbl. cement plant. He must be thoroughly reliable and capable of handling with rapidity any and all breaks which daily occur in cement mills and cause delays. Good salary to the right man. None but parties capable of handling men and machinery as above stated need apply.

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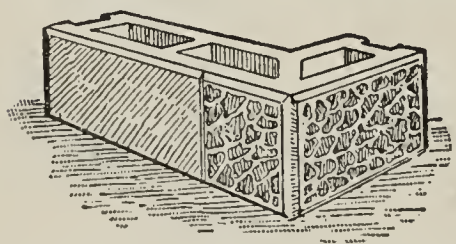

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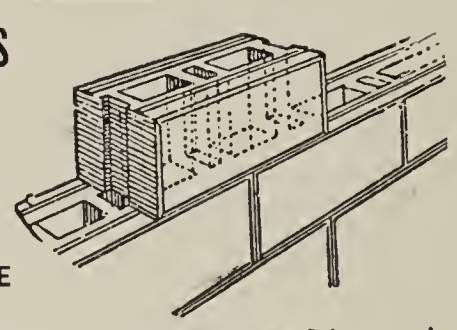

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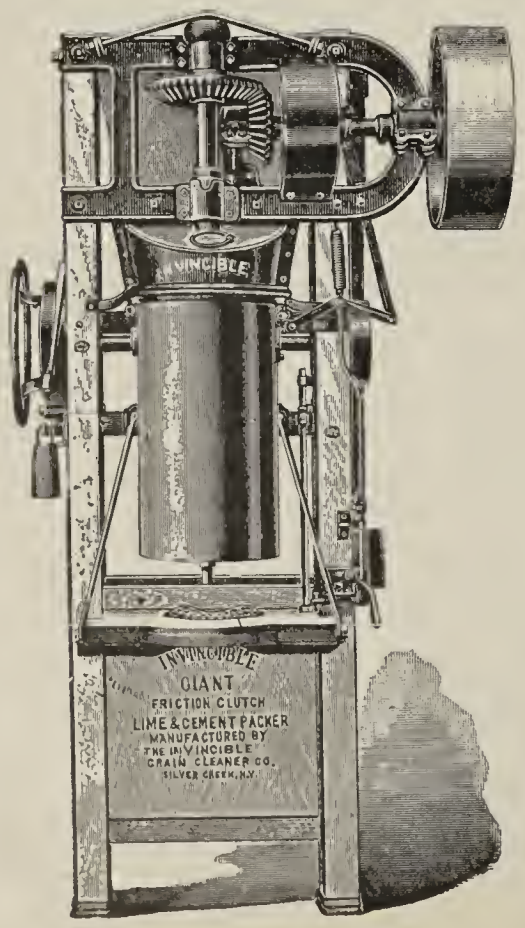

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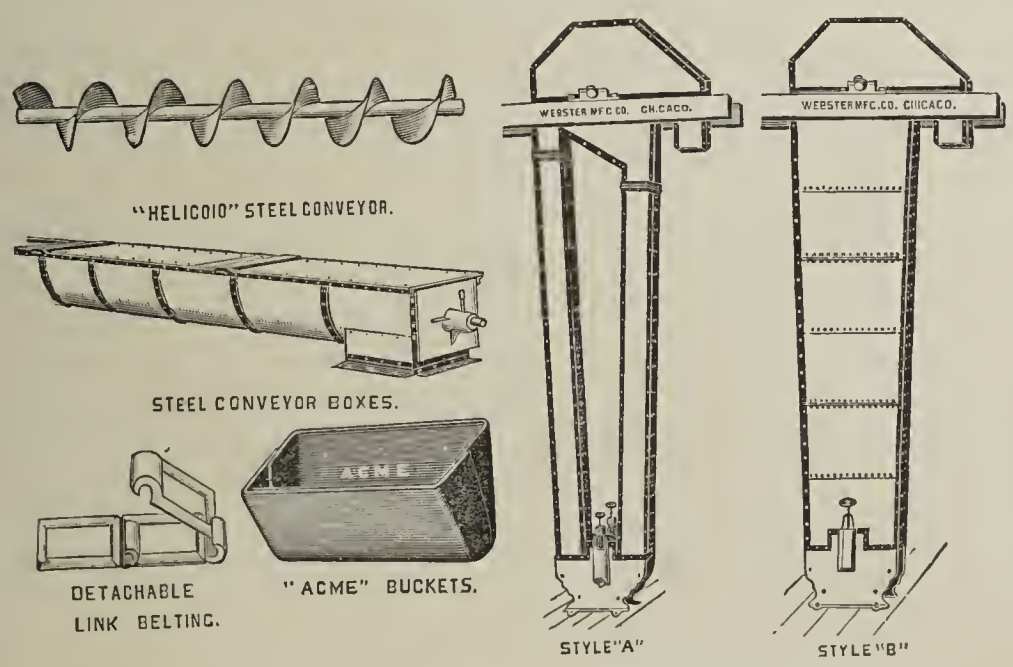

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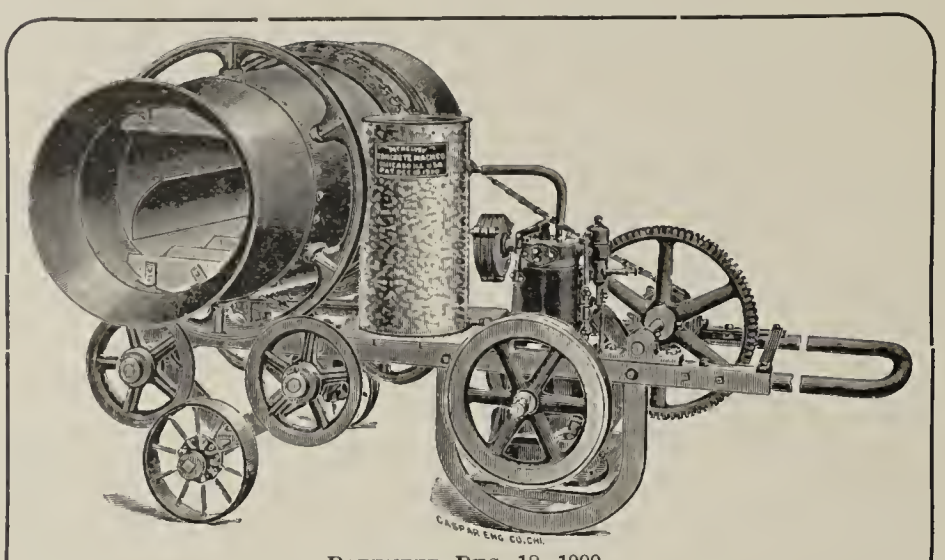

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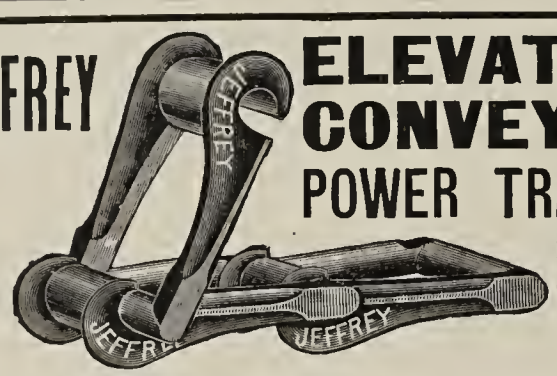

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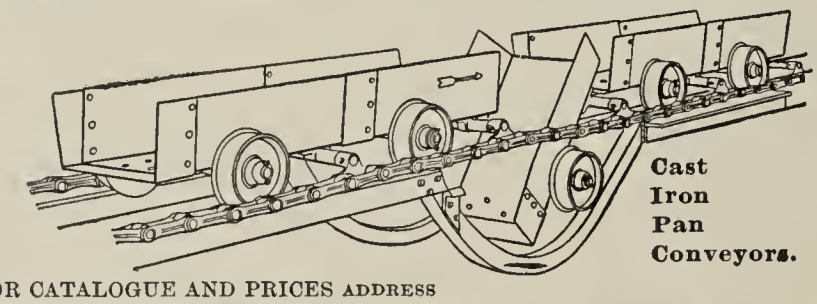

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CONCRETE AND ITS USE,

FROM AN ARCHITECT'S STANPDOINT.

By L. H. SUTCLIFFE.

An exhaustive treatise on the use of concrete construction and concrete and steel constructions, with numerous tables and illustrations. We have an invoice of this publication in transit, price $3.50, from London. Cement and Engineering News, 162 La Salle Street, Chicago, Ill.

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CEMENT
.....AND.....
ENGINEERING NEWS

CONCRETE WORK IN THE CHICAGO TRIBUNE BUILDING.

The new Chicago Tribune building, southeast corner Madison and Dearborn streets, Chicago, now under construction, will be carried on concrete piers, sunk to hard pan 90 feet below the street level. These piers have a diameter of from 5 feet 9 inches to 8 feet 6 inches. The curb wall on Madison street has a froniage of 136 feet, and on Dearborn street 130 feet, constructed entirely of concrete, 18 feet deep throughout. The press-room will be two stories below the street line, the floor being 25 feet below this line, only a portion of the interior building space being carried down to the 25 feet below street level. Our illustration shows the progress of the work with the concrete walls in sight.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher.

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Chicago, November, 1901.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

BRUSH FINISHED CONCRETE.

We had the pleasure of examining several specimens of concrete work finished with a brush. This work was done in the ordinary course of business in laying sidewalks and driveways on the West Chicago boulevard system, where the Park Board has heretofore permitted the use of stone only. This brush finish removes almost entirely the artificial appearance so common and uniform in all concrete work and gives it the appearance of highly finished sandstone of the finest texture, every indication of troweling being removed. Consequently there is no glaze or reflection from the surface or other indication that the work is concrete. Concrete buildings having this finish will make a much finer appearance than has heretofore been possible and therefore more acceptable to the owner.

The neat and attractive appearance which the brush gives to concrete work will do much to broaden the use of this material in all building construction where handsome external finish is desirable.

An ordinary flat paint brush, with extra heavy bristles cut off about one inch below the wood portion of the brush can be used. The fine haired brushes will not answer and will not give the desired result. A much more satisfactory brush, made expressly for the purpose and much more durable than hair, is the Tampico fiber in which copper wire is used for fastening the fiber to the brush frame. The fiber is specially prepared to resist the action of alkalis. The ordinary Tampico brush can be purchased in Chicago at $1.00. The CEMENT AND ENGINEERING NEWS will execute orders delivered by mail throughout the United States, postpaid to any address, simply to bring the brush finish into favor and thereby widen the use of concrete work.

In making the brush finished work the following instructions should be carried out. For instance, in sidewalk work, the construction is carried on as is usual for the foundations. The mortar used for the finishing coat must be mixed with fine screened sand. The ordinary sand used with broken stone should be screened and the finest portion only used. The finishing coat is laid on, troweled down to a smooth, even surface and permitted to harden very slightly, when the brush must be swept straight across the work with a steady motion and uniform pressure. A little practice in getting just the right set in the cement and the knack of hand in using the brush will be necessary. The object to be attained is to produce a ribbed surface about 1-64 of an inch in depth straight across the surface, this will be enough to remove every trace of troweling. Where a driveway with grooves is to be constructed the grooves should be finished before the brush is used. This class of finish is especially adapted to concrete building block where a soft dead-stone finish is wanted. Brush finish for sidewalk has the advantage of not reflecting the light as is the case with trowel finish work. We recommend the use of the brush to our subscribers engaged in concrete construction as a very desirable addition to their handicraft.

We expect to have more to say on this subject in the near future.

WESTERN PORTLAND CEMENT MANUFACTURERS' ASSOCIATION.

DEAR SIR:

The actual result so far of the movement in the West for the betterment of the conditions of the Portland cement industry, are as follows:

First: It has been determined that the manufacturers interested will form an association of a social nature, doing what they can to assist each other and improving the conditions of the Portland cement industry in the middle west.

Second: That they invite the co-operation of Portland cement manufacturers in other parts of the country to the same end.

Yours very truly.

WM. WRIGHT.

The Alpena & Northern Ry. will construct a concrete dock at Alpena, Mich. $25,000 has been invested in Portland cement to go into the work.

The Catskill Cement Co.'s plant at Smith's Landing, N. Y., is to be enlarged to three times its present capacity and will be in full operation early in 1902.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	SEPTEMBER.				NINE MONTHS ENDING SEPTEMBER.			
	1900.		1901.		1900.		1901.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	2,969,184	10,816	93,500	332	85,482,747	333,626	1,806,881	7,040
Belgium..	15,087,449	49,663	16,831,577	52,641	213,546,822	633,884	72,727,528	219,662
France	587,200	2,562	818,400	3,512	11,713,088	41,880	4,688,322	19,707
Germany.....	46,058,287	173,059	21,243,938	73,392	356,812,392	1,338,484	154,163,461	548,687
All Other Europe ...	5,437,200	19,683	221,973	645	25,596,417	79,556	7,234,363	19,428
British North Am...	131,240	764	41,000	210	1,174,690	6,266	1,410,697	6,348
Other Countries.....	2,660,430	11,156	300,000	1,242	9,147,680	39,749	2,717,071	11,525
TOTAL	72,930,990	267,703	39,550,388	131,974	703,473,836	2,473,445	244,748,323	832,397
Domestic Exports of Cements, bbls.	1,321,230	5,502	783,998	3,215	11,711,237	46,224	11,553,922	52,240

There were 11,398,572 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on September 30, 1900, valued at $38,266, against 10,101,197 lbs., valued at $32,387 on September 30, 1901.

Imports of asphaltum or bitumen for September, 1900, were 15,180 tons valued at $52,120; September, 1901—12,264 tons valued at $32,766. For nine months ending September, 1900, 86,266 tons valued at $309,470; for nine months ending September, 1901—109,851 tons valued at $404,144.

H. S. PALMER'S NEW PATENT HOLLOW CONCRETE WALL AND MACHINE FOR HOLLOW BUILDING BLOCKS.

On the 28th of May, 1901, letter patents of the United States, England, France, Germany, Belgium, Austria and Canada were granted to H. S. Palmer of Chicago, Ill., for the construction of buildings which promise in a measure at least, to revolutionize the ordinary method of all classes of buildings. For eleven years Mr. Palmer has given his entire attention to the above method of construction, and, during this time, has secured various patents and made various machines; but the only successful features are all contained in the patents above mentioned, and the new machine which was patented to him April 25th, 1899. It has been evident for a long time to most people who have given the subject any thought, that buildings of the future would be constructed of Portland cement, and the various methods employed for this purpose have been watched with a keen and zealous eye by all who were in any way connected with building operations. The state of the art has advanced step by step, as the improvement in the manufacture of cement (which is the basis of all artificial stone) became recognized, until from the old method of molding it between planks, we can secure in one simple operation the combined effects of durability and beauty, economy, sanitary and many other desirable features, which are indispensable to perfect dwellings and which cannot be overlooked when attention is called to walls of hollow blocks, the vertical flues of which produce the best ventilation, and non-conductors of heat and cold, retaining the rain and moisture which makes walls damp and musty, in the outer shell which is shortly dried as the sun appears, aided by the vertical flues and in connection with the germ proof qualities of cement produces the most sanitary dwellings that has yet been devised. By reference to the accompanying cut it will readily be seen how easy and simple it would be to build walls, if one had the blocks of a suitable size that were true and perfect, and shorter ones to fill between doors and windows and to keep the proper bond. By close inspection the different lengths, designs, corners, joistblocks, ornamental blocks, etc., are plainly seen, and were all produced by hand with the machine partly shown at the left, which is as simple as the blocks themselves, at the rate of two hundred in one day, producing as much wall as nine thousand brick, requiring only four or five men with hoes and shovels. The modern builder need only to have his attention called to these facts to find in them an absorbing interest, sure to ripen into enthusiasm as he pushes his investigation. The above facts are all made possible by the triumphant advent of Portland cement, whose great strength does not require the walls of buildings to be solid, and whose merits are so universally acknowledged that the immense capital invested in its manufacture has reduced the cost to that degree which places these walls below brick, and which is sure to go still lower in cost. The experimental stage of this improved building has passed and many houses and factories can be seen in various parts of the country.

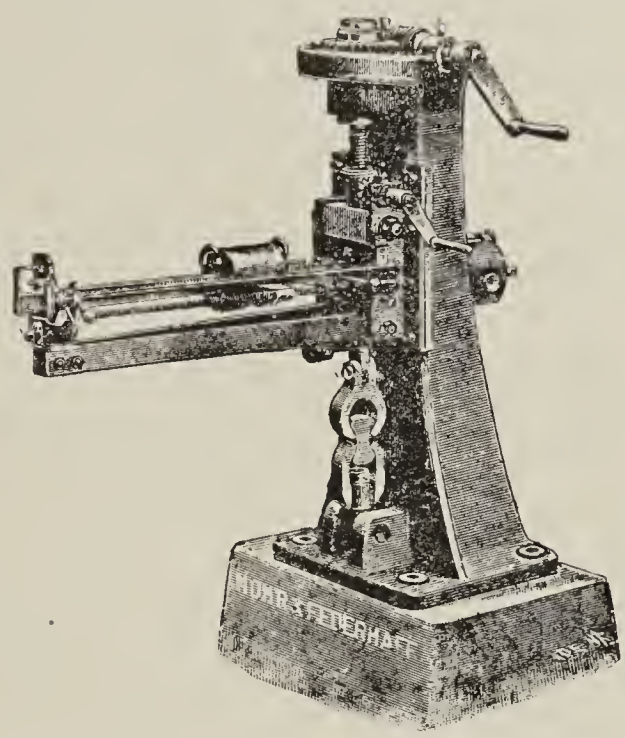
The Fort Scott, Iola & Western is to build a spur from their main line to the works of the Iola Portland Co.

The International Cement Co. of Pittsburg, Pa., has contracted with Jones & Laughlin of that city for slag to be used in the manufacture of its cement. The company will erect works at McKeesport, Pa., on a 10-acre tract of land.

The City of Nashville, Tenn., has contracted for a number of cement watering troughs in various parts of the city. This has inspired a large number of the smaller towns and cities of Tennessee to do likewise. Special committees are being appointed by the various town councils to select sites for these troughs.

A BRIQUETTE TESTING MACHINE.

The briquette machine shown consists of an upright frame. With a scale beam, projecting at right angles to the frame, carrying a sliding weight which is caused to travel to and fro on the scale beam by turning a crank, the short end of the lever being connected with the upper briquette clamp. As the weight on the beam is forced out on the beam a pull is exerted on the briquette held in the clamps or briquette holder. The graduations on the scale beam give the exact pull in pounds exerted on the briquette at the moment of rupture. It is said to be a reliable machine and is manufactured by Mohr & Felderhoff, Manheim, Germany. This firm was awarded a gold medal at the late Paris exposition.



CONCRETE RAILWAY SHOP BUILDINGS.

The Central Railway of New Jersey is erecting several large shop buildings and a round house at Elizabethport, N. J., of concrete after the plans of Geo. Hall, architect and engineer, 150 Fifth avenue, New York City. The foundations are of sand, gravel and cement; for the walls, cement, sand, cinders and furnace slag. The round house will be 400 feet in diameter, with 8-inch walls, expanded metal being used in the foundations. The roofs will likewise be concrete. The walls up to the window sills are poured into molds of matched tongue and grooved boards. An office and storehouse building are of like construction, with the exception of 4-inch instead of 8-inch walls being used.

The National Portland Cement Co. of Durham, Canada, is erecting a large Portland cement plant at the above named place. The buildings are well under way.

CALCULATION OF CEMENT MIXTURES.

By S. B. Newberry.

In the *Thonindustrie Zeitung*, No. 3, page 18, 1901, appeared a paper by Dr. W. Michaelis, Jr., with a supplement by Dr. W. Michaelis, Sr., referring to the so-called "American formula" for cement. The writer recognizes the high reputation of Dr. Michaelis, Sr., and his many valuable contributions to the chemistry of cement, and would be unwilling to enter into a discussion with him on this subject except in the most friendly spirit, and for the sake of arriving at the truth through a courteous exchange of views. With this object the following arguments are advanced in defense of the formula.

Le Chatelier gave the first general expression of the relation of the constituents of cement in his two well-known formulas. The first of these

$$\frac{CaO + MgO}{SiO_2 + Al_2O_3} \leq 3$$

indicates the maximum of bases which a cement may contain. It is generally agreed that magnesia should be omitted from this formula. With this change it may be written

$$x(3\,CaO.\ SiO_2) + y(3\,CaO.\ Al_2O_3)$$

My own experiments, (Jour. Soc. Chem. Industry, Nov. 30th, 1897), showed that this formula represents a proportion of lime slightly beyond the maximum, and I therefore proposed to write it

$$x(3\,CaO.\ SiO_2) + y(2\,CaO.\ Al_2O_3)$$

or, substituting weights for equivalents,

$$CaO = SiO_2 x\, 2.8 + Al_2O_3 \times 1.1$$

It was clearly stated that this formula represents the *maximum* of lime which can be used, and that this maximum can only be reached by extremely fine grinding and perfect mixing of the materials. It was never suggested that this formula was intended to represent the composition of commercial cements, or to be closely followed in the calculation of cement mixtures. It was claimed, however, that the formula is applicable to materials of varying composition, from aluminous to highly silicious, and that with sufficiently fine grinding of the mixture the more nearly its composition approaches that called for by the formula the better will be the quality of the product. This maximum of lime can be reached only under conditions of fine pulverization which can scarcely be realized on a manufacturing scale. It is therefore necessary in actual practice to diminish the proportion of lime slightly, in proportion to the coarseness of the raw material. It is impossible to propose a formula which shall provide for bad mixing. When the cement chemist has stated the correct relation of the constituents of cement under ideal conditions he may safely leave it to the manufacturer to vary the rule more or less to suit his own requirements.

The writer's modification of the Le Chatelier formula appears to have found favor with many chemists, and owing to its simplicity and convenience to have been of use in practical experiments with new cement materials. Dr. Michaelis agrees that it leads to an approximately correct result in the case of materials rich in alumina, but claims that with silicious materials it gives cements too high in lime. He states that he has been unable to obtain sound cement from material containing over 78 per cent calcium carbonate, and reminds me, in spite of my repeated statements of the applicability of the formula only to the most finely ground materials, that my experiments were made with much finer grinding than is customary in practice!

Dr. Michaelis claims, also that the cements which I prepared in accordance with the formula were burned at much higher temperature than that obtained in actual manufacture, and refuses to accept my assurance that this was not the case. This difference of opinion may perhaps be easily explained. In the United States Portland cement is burned almost exclusively in the rotary kiln with the use of pulverized coal as fuel. The product of the present year will be at least 10 million barrels. The temperature reached in the rotary kiln is very difficult to measure, but is certainly far higher than that obtained in the vertical kilns used in Germany. The writer's experiments were made in a Fletcher laboratory furnace with gas as fuel. It is true that the temperature was not determined; it was, however, certainly no higher than that of the rotary kilns, since samples of ordinary cement mixture, burned under the same conditions, gave clinker which was not overburned. It is true that the mixtures free from iron, made according to the formula, were less fusible than the mixtures used in practice, and gave light, porous clinker. The cements obtained were, however, of good hardening properties and sound in the hot test, showing that the burning had been complete. It is also true that highly silicious mixtures were less fusible than those high in alumina; the thoroughness of the combination and soundness of the cement were, however, equal in both cases. It appears to the writer that the customary degree of *sintering* need not always be reached to produce a good product; that fineness of grinding of the raw material may take the place of high temperature in burning, and that an extremely perfect mixture may be very infusible and still show complete combination at temperatures which do not exceed those ordinarily employed.

As an example of the inapplicability of the writer's formula to mixtures high in silica, Dr. Michaelis gives the analysis of a cement which proved satisfactory, also the composition of a cement calculated according to the formula from that of the same materials.

These are as follows:

	Cement.	Calculated according to formula.
SiO_2	26.13	22.98
Al_2O_3	4.77	4.19
Fe_2O_3	2.40	2.11
CaO	65.00	68.94
MgO&c	2.00	1.78
	100.30	100.00

Dr. Michaelis states that no one will assert that such a cement as that represented by the latter analysis has ever been made on a manufacturing scale and found satisfactory. With this statement the writer fully agrees. This is, however, due to the imperfection of our manufacturing processes, and also to the various impurities which enter into the product and greatly modify its composition from that calculated from the raw material, as will be pointed out later.

A cement of the composition shown by the second analysis given above, and of faultless quality, can, however, readily be made by fine grinding of the raw material and burning at a temperature easily reached in the rotary kiln. To prove this, a mixture of clay, finely ground quartz and pure chalk was prepared, ground to pass a sieve of 6,200 meshes per sq. cm. (200 per linear inch), and further mixed and ground with water. After drying, the mixture was burned one-half hour in a Fletcher gas-furnace provided with a magnesia cylinder. The resulting clinker was well sintered but by no means fused. Its composition was found to be as follows:

SiO_2	22.80
Al_2O_3	4.50
Fe_2O_3	1.98
CaO	69.40
MgO. etc	1.32
	100.00

The formula

$$CaO = 2.8\,SiO_2 + 1.1Al_2O_3,$$

applied to the above, calls for 68.79% lime. The cement is, therefore, a little higher in lime than that calculated.

Both the light burned and harder burned portions yielded on grinding a cement of excellent hardening properties, and both stood faultlessly the usual pat test in steam over boiling water. As Dr. Michaelis suggests, his paper on "Fused Portland Cement" is well known to me, and was read with great interest at the time of its publication. There is here, however, no question of fusion, and the soundness of the cement obtained is due to the perfection of the mixture. I am sending Dr. Michaelis a sample of both clinker and cement, and hope he will communicate to this Journal the results of his inspection of it. The point of difference between us is a simple one. He claims that highly silicious cements corresponding with the formula can be obtained only by fusion. I contend that sufficiently fine pulverization will accomplish the same result, and allow burning at moderate temperature.

The same mixture was also burned in an ordinary kiln with natural draft, using petroleum coke as fuel. Well-sintered clinker was obtained, which on grinding gave cement of constant volume. On analysis it was found, however, that the ash of the fuel had considerably changed the composition of the clinker, giving a product lower in lime and higher in silica than that burned with gas.

Referring to Dr. Michaelis' statement that the cement corresponding to his first analysis proved satisfactory in quality, I would say that with highly silicious mixtures a much greater variation in proportions is certainly allowable than in those rich in alumina. Nevertheless, the cement in question, with 26.13 silica and 65.00 lime, appears to me decidedly over-clayed, and likely to show a decided tendency to fall to dust on cooling; it would probably also show higher strength and sharper hardening qualities if the proportion of lime were considerably increased. Dr. Michaelis does not state, however, whether this cement is a commercial product, or with what fuel it was burned. If burned with coke in an ordinary kiln a large part of the silica may have come from the ash, and the cement may even have been made from a mixture of a composition approaching closely to that called for by the formula.

An interesting paper on the subject of the cement formula, by Dr. L. Erdmenger, appeared in No. 79 of the *Thonindustrie Zeitung*, p. 1283, 1901. Dr. Erdmenger points out most clearly the important influence of the ash of the fuel and addition of gypsum on the composition of cement, and shows that analysis of the finished product throws but little light on the relation of the constituents of the raw material used. He states that the German cement mentioned in my original paper, the composition of which corresponded with the formula, contained a considerable proportion of hydraulic lime. I do not doubt the correctness of this assertion, and am forced to believe that the agreement of the analysis of this cement with the formula was accidental.

In order to trace the effect of the ash of the fuel, and to determine what the usual practice is in regard to the composition of the raw mixtures, I have lately, with the help of my assistants, Messrs. J. F. Davis, C. H. Sontag and M. Smith, made a series of careful analyses of the raw material and clinker from some of the leading American factories. These are all from works using rotary kilns; the samples of clinker were taken one hour later than those of the raw material, since the passage of the charge through the kiln requires about one hour. The results are shown in the following tables:

VULCANITE PORTLAND CEMENT CO., PHILLIPSBURG, N. J.

	Mix.	Clinker, calculated from mix.	Clinker found.
SiO_2	12.38	19.16	21.26
Al_2O_3	5.55	8.59	7.64
Fe_2O_3	1.69	2.62	2.86
CaO	42.62	65.97	63.74
MgO and SO_3	2.37	3.66	3.28
Loss	34.70	.....	0.66
	99.31	100.00	99.44
Formula requires CaO	40.77	63.10	67.93

LEHIGH PORTLAND CEMENT CO., ALLENTOWN, PA.

	Mix.	Clinker, calculated from mix.	Clinker found.
SiO_2	14.33	22.18	22.96
Al_2O_3	4.32	6.68	6.78
Fe_2O_3	1.46	2.26	2.54
CaO	42.69	66.08	63.95
MgO and SO_3	1.81	2.80	2.94
Loss	35.14	....	....
	99.75	100.00	99.17
Formula requires CaO	44.87	69.45	71.75

SANDUSKY PORTLAND CEMENT CO., SANDUSKY, OHIO.

	Mix.	Clinker, calculated from mix.	Clinker found.
SiO_2	13.14	21.16	22.10
Al_2O_3	3.59	5.78	6.40
Fe_2O_3	1.89	3.05	3.04
CaO	41.98	67.62	65.44
MgO and SO_3	1.48	2.39	2.42
Loss	36.94	.....	0.06
	99.02	100.00	99.46
Formula requires CaO	40.73	65.61	68.92

SANDUSKY PORTLAND CEMENT CO., SYRACUSE, IND.

	Mix.	Clinker, calculated from mix.	Clinker found.
SiO_2	13.50	22.02	22.33
Al_2O_3	3.43	5.60	5.53
Fe_2O_3	1.27	2.07	3.28
CaO	40.76	66.49	64.40
MgO and SO_3	3.27	3.82	3.61
Loss	38.30	....	....
	100.53	100.00	99.15
Formula requires CaO	41.57	67.82	68.61

It will be noted in the above tables that the first and third analyses of raw mixture show an excess of lime over that required by the formula, while in the second and fourth there is a deficiency of lime. The average of the lime present in the four samples is almost exactly equal to that calculated:

Found, 42.01; calculated, 41.99.

These samples were chosen at random, and it is probable that this close correspondence is more or less accidental. It is evident, however, that in American practice the proposed formula is not found, on the average, to give cements too high in lime.

When we turn to the analysis of the clinker, how-

ever, we find a striking confirmation of Dr. Erdmenger's views on the effect of the ash of the fuel. In all four cases the lime is found to be about two per cent lower than that calculated from the raw material, while the silica and alumina are correspondingly increased. It is therefore evident that analysis of the clinker or finished cement gives but little information in regard to the composition of the raw material. It may, however, be argued that the ash of the fuel enters into the composition of the clinker, and thus replaces a certain amount of clay. This is undoubtedly, to some extent, the case; however, a large part of the ash adheres to the outside of the lumps of clinker in the hottest part of the kiln, and thus fails to become uniformly mixed with the charge. No doubt the ash acts as a flux, and plays an important part in overcoming the bad effects of coarse mixing or excess of lime. It is probable that the effect of the fuel ash on the composition of the product is greater in the rotary kiln than in those of the vertical type, owing to the larger proportion of fuel used in the former.

Dr. Erdmenger states that he makes use of the proposed formula in his work, modifying it to read

$$\text{Lime} = 2.5\ SiO_2 + 1.0 \text{ to } 0.75\ Al_2O_3$$

It is possible that this may represent the composition of certain finished cements. When applied to the calculation of the raw material, however, I am confident that any lower figure than

$$\text{Lime} = 2.7\ SiO_2 + 1.Al_2O_3$$

would give too high a proportion of clay for the best results.

On the basis of analyses published in "Ziegel und Cement" Dr. Erdmenger concludes that American Portland cements are, on the average, lower in lime than the German, and points out that this by no means agrees with my proposed formula. It appears to me probable that the samples referred to were injudiciously chosen. My own analyses of the leading American cements show almost invariably a percentage of lime ranging from 63 to over 65. However, Dr. Erdmenger has himself pointed out the lack of significance of analyses of finished cement, and this is abundantly confirmed by the table given above. Further, it should be noted that the rotary kiln allows the use of mixtures *lower in lime* than could be successfully burned in kilns of the older type, since the quick burning and quick cooling of the rotary process avoids entirely the "dusting" on cooling so common with vertical kilns. This quick burning and quick cooling was especially recommended by Dr. Michaelis in his paper on "Fused Portland Cement" published in 1892, while the rotary kiln was still in the experimental stage.

Dr. Erdmenger suggests that my motive in proposing the much discussed formula may have been to urge American cement chemists to the greatest possible efforts to improve the quality of their product. In regard to this it need only be said that I have always preached *fineness of grinding of the raw material*, believing that this is the first essential in cement manufacture, and that faulty character of product results more often from carelessness in this regard than from all other causes combined. As to the formula itself, it is intended to mark a *limit* which cannot be safely passed, and which can only be reached by most perfect preparation of the raw mixture. It is not intended to represent the average of common practice in the proportioning of the materials, still less the average composition of clinker or finished cement. So understood, it has been of great service in my hands, and is, I believe, capable of affording useful information to others.

American cement manufacturers will certainly agree with Dr. Erdmenger that to equal the best German cements is a task worthy of all their efforts. If we should surpass the German cements in quality it will not be by raising the proportion of lime, but as a result of careful scientific study of the process of manufacture on the lines which Dr. Erdmenger, Dr. Michaelis and other eminent German cement chemists have so ably followed.

CLARK COUNTY, INDIANA, CEMENT MILLS FEAR COMPETITION.

Those who profess to know say that the companies interested in the cement industry, which has been carried on so extensively in Clark county, Ind., for years past, are alarmed over the establishment of Portland cement mills in different parts of Indiana. They say the competition will seriously interfere from the beginning and in time will make the business unprofitable in this vicinity.

The cement corporations became aroused over the action of the Portland Cement Co., at Portland, which in 1899 erected a $500,000 plant, doubling its capacity. The mill, when finished, will represent an outlay of $1,000,000. Its daily capacity will be 1,500 barrels of cement.

At Stroh, Lagrange county, the Wabash Portland Cement Co. is arranging to double its capacity. Last year it completed its plant, which cost $500,000. Six hundred barrels of cement are manufactured daily by this company. The claim is made that the Portland cement made in Indiana is as good as the imported product.

A plant to cost $500,000 is being built at Bristol, in St. Joseph county. A dam to cost $40,000 is being built across St. Joseph river. Water power will be used to produce electricity, the motive power.

A plant will be put up at Milford, Kosciusko county. Goshen parties have purchased marl lands costing $11,600. This land is the beds of Mud and Colley lakes. Here a $500,000 plant will be built. At Mitchell and Milltown $500,000 Portland cement mills are being built. These mills propose to use oolitic limestone instead of marl. This stone contains a large percentage of purest carbonated lime, but the cost of handling will be greater than marl, owing to the necessity of reducing the stone to fine powder.

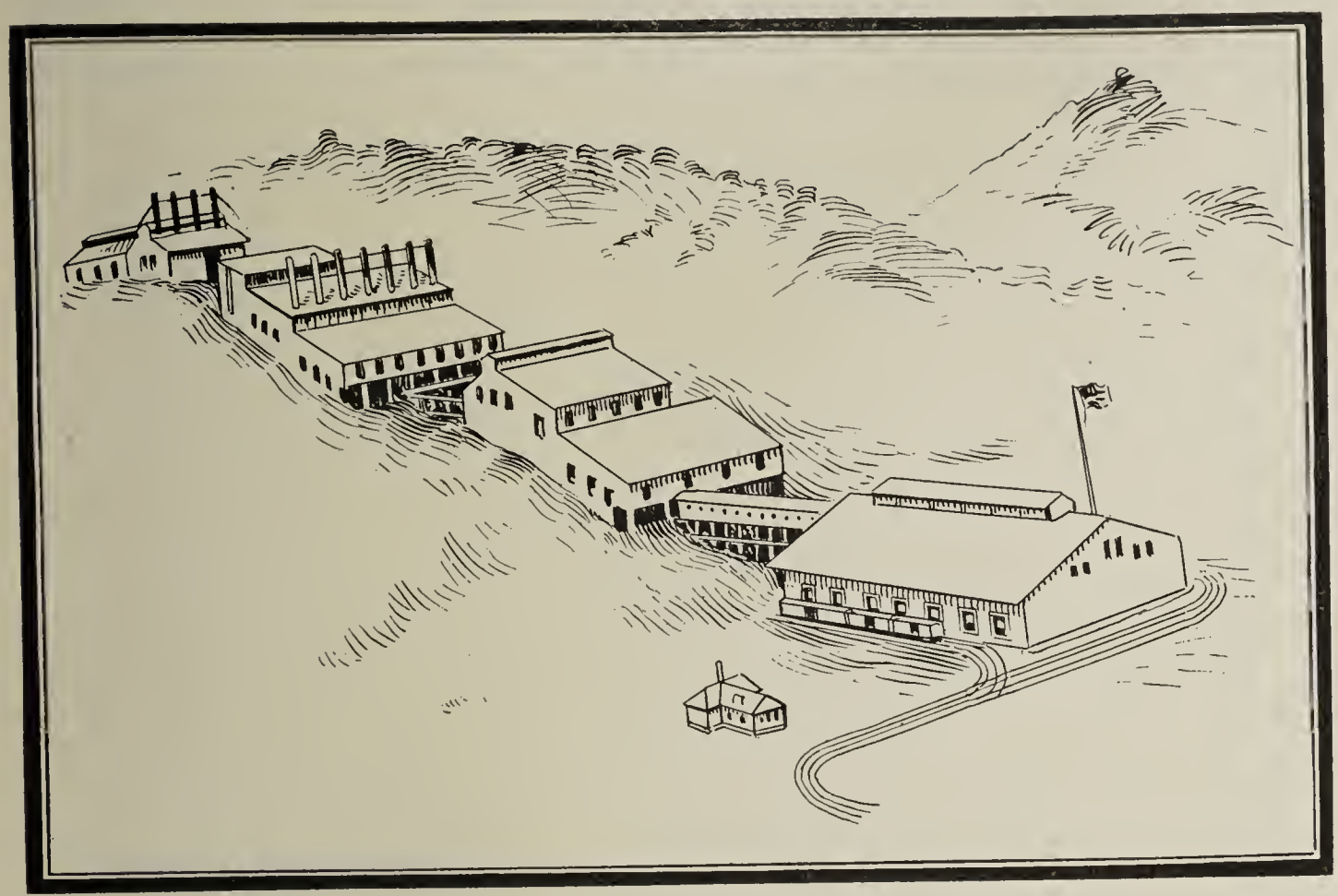
It is predicted that by 1903 Indiana will have five big modern plants in operation producing 4,000 barrels of Portland cement daily, or 1,400,000 yearly. In the United States there are forty-one Portland cement mills. The combined production last year was 7,000,000 barrels.

The Portland cement materials of Indiana are as great a boon as natural gas has been, it is claimed. There are thirty-two deposits in the counties of Kosciusko, Steuben, Elkhart, Noble and St. Joseph. Each one of them is capable of running one plant of 500 barrels or more a day for thirty years. There are deposits that will run 5,000-barrel mills a century, it is said, and there is room in Indiana for fifty or 100 big cement mills. —*Louisville (Ky.) Journal.*

A new illustrated mining circular has been issued by the Sturtevant Mill Co. of Boston, Mass., fully describing their well-known roll jaw fine crushers, which reduce the hardest ores to $\frac{1}{4}$ inch without the use of screens. Also complete information regarding their powerful centrifugal crushing rolls which have three times the capacity of other rolls of equal dimensions. These with many other mining machines of their manufacture complete a circular which cannot fail to interest parties using this class of machinery. The Sturtevant Mill Co. will be pleased to mail this to interested parties upon request.

THE PACIFIC PORTLAND CEMENT COMPANY'S PROPOSED PLANT.

The accompanying illustration shows the arrangement of the building of the Pacific Portland Cement Co.'s proposed plant which is to be operated on the gravity plan of conveying the materials forward in the process of manufacture from the high end of the plant to the storehouse for the finished cement. The mill site and grounds cover 30 acres of land located near Suisun, Solano county, Cal. The machinery will be operated by electricity furnished by the Bay Counties Electric Power Co. An electric railway will be constructed from Suisun to the works.



The Midland Portland Cement Co. has taken out papers of incorporation in New Jersey, with a capital stock of $1,000,000. The incorporators are O. M. Packard, J. L. Benedict and V. A. Foulk, all of 15 Exchange place, Jersey City, N. J. The charter of the company permits it to manufacture all kinds of brick, cement pipe, etc.

Prof. L. L. Dyche, zoologist of the University of Kansas has constructed an elk statute of Portland cement measuring about 10 feet from the tip of the tail to the top of the horn. The skeleton of the statute is built up of oak for the body and steel rods for the legs. The form being outlined by winding wire around the wood and iron frame work. This was next covered with Portland cement mortar and tooled down while green to the proper outlines. Fifteen barrels of cement being consumed in the figure.

THE CEMENT TRADE.

A few years ago the idea of importing cement in England would have been ridiculed. The official return of the imports of cement to the United Kingdom for the nine months from January to September, 1901, however, shows a total of 156,760 tons, against the corresponding period in 1900 of 70,439 tons—*i. e.*, an increase of 86,321 tons, or 123 per cent. The imports for September alone are 21,249 tons, against September, 1900, 8,627 tons, or an increase of 12,622 tons, or 146 per cent. Amongst the principal ports the imports for the nine months ending September this year, as compared with the corresponding period last year, have been as follows:

	Tons.		Tons.		Tons.	Pct.
Cardiff.....	5,897	agst	1,587	an incr'se of	4,310	or 271
Dublin.....	2,769	"	322	"	2,447	" 759
Dundee	4,795	"	1,570	"	3,225	" 205
Glasgow 30,017		"	20,104	"	9,913	" 49
Grangemouth 6,120		"	3,778	"	2,342	" 62
Lancaster....	5,160	"	542	"	4,618	" 852
Leith.....	7,518	"	5,811	"	1,707	" 29
Liverpool 25,857		"	5,350	"	20,507	" 383
London	9,388	"	3,135	"	6,253	" 199
Manchester..16,234		"	4,723	"	11,511	" 244
Newcastle....	4,156	"	2,075	"	2,081	" 100
Southampton	3,082	"	686	"	2,396	" 349

The low freights from Antwerp, compared with those charged by the English shipping ring, perhaps to a certain extent explain the increase in such ports as Liverpool and Leith; but this does not apply to London, where the raw materials, chalk and clay, are on the spot, coke can be had from the London gas companies, and the cost of bringing the manufactured article from the works to the London market is only 1s. 6d. per ton, as compared with 4s. 6d. to 5s. from Antwerp. Yet the Associated Portland Cement Manufacturers, with their command of the Thames and Medway Works, are allowing foreign manufacturers to make headway in the London market, while they themselves are reducing their output by closing various works of their own for repairs or other purposes. Surely such a policy must be disastrous. If foreign imports of cement are allowed to grow year on year at the increasing rate of 199 per cent, the foreign manufacturers will shape their output to supply the extra demand; their cement will be known possibly to be as satisfactory as that manufactured in England; and then with works adapted for their new market, and all the advantages of an established business, they will, of course, go to great extremes to maintain their position, which will mean that the English manufacturer, to endeavor to regain the trade, must cut prices to a ruinously low figure.

It is sincerely to be hoped that the directors of the Associated Portland Cement Manufacturers, and also the outside manufacturers on the Thames and Medway, will realize at once the rapid inroad that is being made into their market, and, by prompt and decisive measures, show us in subsequent returns that there is no need to go abroad for what is manufactured so near to us at home, and that they realize the full force and truth of the old proverb, "A stitch in time saves nine." PORTLAND CEMENT.

LONDON, Oct. 25, 1901.

John E. Sparrow has assumed the business of Sparrow, Freidenberg & Co., importers and exporters of Portland cement, 15 to 25 Whitehall street, New York City.

The chief engineer of the United States army has recommended an appropriation of $125,000 to begin the reconstruction of the inner section of the Milwaukee breakwater. Capt. Warren, United States engineer in charge of the work now in progress recommends that the superstructure be concrete which has been approved for the work. The present superstructure is wood resting on concrete foundations constructed in 1871. Successive appropriations will be required to complete the work throughout with concrete. The increased price of timber and the decline in cement prices is favoring the use of concrete for this class of harbor improvements.

THE DESTRUCTION OF HYDRAULIC CEMENT BY THE ACTION OF SEA-WATER

AND THE SUPERIORITY OF PUZZOLANE OVER LIME IN THE MANUFACTURE OF CEMENTS INTENDED FOR USE IN MARITIME BUILDINGS.

By Professor Schuljatschenko.*

The stability of maritime buildings in the construction of which puzzolane mortar has been employed has been proved over and over again, but the primary cause of this valuable property is, even at the present moment, almost unknown to the technical world. On account of this ignorance, the majority of those who are called upon to decide whether it is better to employ a mortar containing puzzolane, or one compounded with ordinary cement, see only in it a question of price, and therefore do not make any practical distinction between the use of one or the other. It has been shown, however, by several technicists who have studied this subject, that mortars containing either hydraulic lime or puzzolane resist the effect of the salts contained in sea-water, in so far as these mortars are impervious to the action of those salts; but it must be noted that although this theory is to some extent correct, the chemical reactions and interchanges which occur between the salts contained in sea-water and the different bodies which form the constituents of the mortar have never been properly recognized, although these reactions and interchanges constitute a more important factor in the resistance of the mortar to the action of sea-water than its impermeability. Professor Rivot, the well-known French chemist, who some years ago made certain studies on the chemical reactions which occur between the sea-water and puzzolane mortars, suggested that these reactions were caused by the action of the magnesia salts contained in the sea and the lime found in the mortar, opining at the same time that the destruction of ordinary mortar or cement was caused by the same salts. The chemical interchange was, however, not observed by this gentleman.

In the year 1893 I undertook the study of the same subject, and soon noticed that there was one very important question to be decided before any satisfactory conclusion as to the cause of the deterioration or stability of the different mortars could be arrived at. This question was: Can puzzolane mortars, which have been exposed to the action of the salts contained in sea-water, become so affected by this action that their composition is materially changed into one which will resist any further action of these salts, or not? In order to decide this, I made two analyses of mortars containing different kinds of puzzolane. One of the mortars which I analysed belonged to the ancient Roman period, and was obtained for me by a diver from one of the piers in the harbor at Puzzuolani, and which, although they have been exposed to the action of the sea-water for nearly twenty-two centuries, are found at the present day to be in perfect condition. This mortar was brought up from a depth of 11.5 meters, or a little over 12½ yards, was fairly hard, and had a very good cohesion. The modern mortar was obtained from a block of beton in the mole of St. Vincent, in the harbor at Naples. This mortar, which was brought up from some meters depth below the sea level, was only some twenty years old, and its cohesion was as perfect as that of the ancient mortar. The puzzolane employed in the ancient Roman mortar was of the trachytic variety, found in the neighborhood of Bajæ, while that used in the modern mortar was of the basaltic form so common in the neighborhood of Vesuvius. When these mortars were examined in the moist state, they were found to be as yielding as chalk, and showed under the microscope a structure of leaf-shaped crystals, alternating with hard metallic-like grains of unequal size and shape. After the mortar had been thoroughly dried, however, the crystals were no longer visible, and the mortar became much harder.

The mortars were placed on unslaked lime in order that they might be the more thoroughly dried, and then analysed. The following tables give the result of this analysis:

1. *Insoluble parts in a Normal Hydrochloric Acid Solution.*

Ancient Roman mortar = 33.68 per cent.
Modern mortar = 52.10 per cent.

2. *Composition of the Soluble Parts in a Normal Hydrochloric Acid Solution.*

	Roman mortar.	Modern mortar.
Water	17.03	20.56
Carbonic acid	1.11	1.48
Silicic acid	33.64	32.60
Alumina	32.61	28.38
Oxide of iron	1.68	4.23
Lime	5.66	6.67
Magnesia	3.56	2.35
Potash }	5.15	2.86
Soda }		1.82

The results of this analysis supply us with the proof that we require. They show us that a good puzzolane mortar will, in a relatively short period and without losing its original cohesive properties, so change in its chemical composition through the action of the salts contained in sea-water, that it will resist the further action of these salts through countless centuries.

After I had by means of the above analysis fully settled this point, I at once turned my attention to the study of the influences which brought about this change in the chemical composition of puzzolane mortars. It was necessary, in order to properly carry out the experiments required in this branch of the study, to prepare in the laboratory several kinds of mortars from materials the chemical composition of which was thoroughly known. To this end, I obtained several specimens of trachytic and basaltic puzzolane from different districts, and after having found their chemical composition by a careful analysis, I compounded a normally proportioned mortar from each. In addition to this, I made an ordinary lime mortar, in order that I might compare the results obtained from the puzzolane mortars with an ordinary lime mortar. These I made into cubes measuring 5 centimeters (nearly 2 inches), and allowed them to harden for some days in the air. The cubes were then placed in a solution containing 29.61 grammes (nearly 445 grains) of chloride of soda, 11.96 grammes (about 180 grains) of sulphate of magnesia, and then saturated with carbonic acid. The mortar was kept in the solution for four years, the solution being frequently changed in order that the reaction might be complete. At the end of this period I broke the cubes into pieces about the size of peas, and washed these pieces in the same solution until no further reaction was observable. After this I washed them again in distilled water until all trace of chlorine had disappeared, and then dried them on unslaked lime. The analysis of these mortars gave the following figures:

1. *Mortar containing Trachytic Puzzolane from Bacoli.*

	Per cent.
Carbonic acid	7.25
Silicic acid	52.77
Alumina	17.00
Oxide of iron	4.84
Lime	3.28
Magnesia	1.35
Potash	7.65
Soda	4.94
	99.08

2. *Mortar containing Basaltic Puzzolane from Vesuvius.*

Carbonic acid	2.21
Silicic acid	47.10
Alumina	21.99
Oxide of iron	8.01
Lime	9.91
Magnesia	1.56
Potash	6.01
Soda	2.56
	99.35

3. *Ordinary Mortar containing Lime.*

Carbonic acid	2.61
Silicic acid	0.63
Alumina	1.37
Oxide of iron	0.13
Lime	91.84
Magnesia	2.44
Potash	0.16
Soda	0.15
	99.33

* Professor Schuljatschenko is one of the best known authorities in Russia on building construction and engineering. He has been for some years Professor at the Technical Institute of Moscow, and is besides a General of the Imperial Engineers.

4. Mortar containing Basaltic Puzzolane.

	Total.	Soluble in normal hydrochloric acid.	Insoluble.
Water	3.60	3.60	.....
Carbonic acid	5.79	5.79	.....
Silicic acid	40.95	12.81	28.16
Alumina	19.95	9.56	9.99
Oxide of iron	6.61	0.71	5.90
Lime	14.84	7.72	7.12
Magnesia	1.63	0.81	0.62
Potash and soda	7.23	2.79	4.44
	100.60	43.79	56.23

5. Mortar containing Trachytic Puzzolane.

	Total.	Soluble in normal hydrochloric acid.	Insoluble.
Water	8.47	6.99	1.48
Carbonic acid	7.53	7.53	.....
Silicic acid	43.29	10.61	32.68
Alumina	17.41	7.13	10.28
Oxide of iron	3.42	0.95	2.47
Lime	11.57	10.23	1.34
Magnesia	1.70	0.62	1.08
Potash and soda	6.61	1.42	5.19
	100.00	45.48	54.52

When one compares these results with those given in the first analysis, it will be easily seen that the mortar prepared in the laboratory possesses a comparatively greater quantity of lime than that which had been subjected to the action of true sea-water. If, however, the mortar had been subjected to the action of the solution described above for a greater length of time, the quantity of lime and carbonic acid would have considerably decreased, and then the proportions would have been similar. Thus, we should have obtained the following figures in:

1. Mortar containing Trachytic Puzzolane.

TOTAL PERCENTAGES.

	Total.	Soluble in normal hydrochloric acid.	Insoluble.
Water	10.22	24.56	2.71
Silicic acid	52.23	37.28	58.94
Alumina	21.00	25.05	18.85
Oxide of iron	4.13	3.34	4.53
Lime	2.40	2.29	2.45
Magnesia	2.05	2.18	1.98
Potash and soda	7.97	5.30	9.54
	100.00	100.00	99.00

2. Mortar containing Basaltic Puzzolane.

TOTAL PERCENTAGES.

	Total.	Soluble in normal hydrochloric acid.	Insoluble.
Water	4.14	11.75	.....
Silicic acid	47.15	41.82	50.06
Alumina	22.51	31.21	17.79
Carbonic acid	8.60	1.14	12.67
Oxide of iron	7.61	2.31	10.49
Potash and soda	8.32	9.10	7.89
Magnesia	1.64	2.64	1.10
	99.97	99.97	100.00

From these tables it will be seen that although there has been a decrease in the proportions of the carbonic acid, lime, and other alkalies, yet there has also been a considerable increase in the proportions of water, silicic acid and alumina. Now, if we separately examine the composition of the active part, or cement, and the passive part, or puzzolane, we shall immediately see that those bodies in the active part which react against the lime have in this reaction lost in silicic acid and alkaline matter, whilst the passive part has gained in silicic acid and alkaline silicates. This interchange in matter was suggested by Professor Rivot some years ago, and he attributes the superior qualities of puzzolane mortars to this interchange, and the subsequent loss in lime.

In my experiments on this subject, I noticed that a small quantity of silicic acid and of sesquioxide of aluminium apparently passed over into the solution. This loss was one which had never before been observed, and after some careful calculations and experiments I was enabled to establish the fact that puzzolane mortars lose in silicic acid, alkalies, and sesquioxide of aluminium by the mere action of sea-water, and if there be lime present the loss in these substances is greatly increased. In these researches I found that 12 grammes (180 grains) of mortar containing trachytic puzzolane lost, in the absence (A) or in the presence (B) of lime, the following substances in the proportions given in the following table:

	A.	B.
Silicic acid	0.1434	0.3000
Aluminium sesquioxide	0.0228	0.0720
Carbonic acid	.....	0.2915
Potash and soda	0.0691	0.2172

The changes in composition which we have noted are much stronger in trachytic than in basaltic puzzolane. This is on account of the chemical composition of the basaltic variety, which being richer in combinations is more easily affected by acids, and thus less liable to the action of alkaline matter and consequent interchange. In addition to this, the proportion of water in the soluble part of basaltic puzzolane is much lower than that found in the soluble part of trachytic puzzolane. Moreover, basaltic puzzolane is very rich in crystallized matter and contains very little dross or of scoriated substances. From the experiments which I have enumerated I am enabled to give the following conclusions:

1. The salts contained in sea-water change the cement of a puzzolane mortar into a hydrated silicate of alumina, which is not mixed with too great a quantity of either carbonate of lime, magnesia or any other alkali.

2. This silicate is on account of its composition not affected in any way by the action of the salts contained in sea-water.

3. That in puzzolane mortars which are exposed to the direct action of sea-water the lime almost entirely disappears, and its place is taken by the silicates of the various alkalies which are found in sea-water.

Before concluding this article, I wish to give a short account of the action of sea-water upon buildings constructed with mortar containing Portland cement. The manufacturers of this cement, and indeed many technical men also, appear to be thoroughly convinced that such buildings have a most perfect stability, while, on the other hand, an ever-increasing majority of cement users are in great doubt as to this stability. This question was made the subject of considerable argument at the International Builders' Congress held at Paris in July, 1900, when Professor Le Chatelien, who supported the views of Professor Michaelis, held that cement made with Portland cement quickly deteriorated when exposed to the action of the sea on account of the formation of sesquioxide of alumina and sulpho-aluminate of lime. Many experiments were made in order to show whether this theory was correct or not; some of the experiments were made with sea-water, and in other cases a solution resembling it in composition was employed, while some of the experimenters used solutions of chloride of magnesia or sulphate of magnesia. Finally, the cement was tested with a solution of sulphate of lime, and this solution was found to have a greater destructive power on the cement than either the sea-water or the solutions of magnesium salts. My own experiments on this subject, in which I tested the Portland cement in solutions of chloride of magnesia and a mixed solution of sulphate of magnesia and chloride of soda, prove that it is impossible for the sulpho-aluminate of lime to form in sea-water, and if present would be quickly destroyed. The following is the result of my experiments:

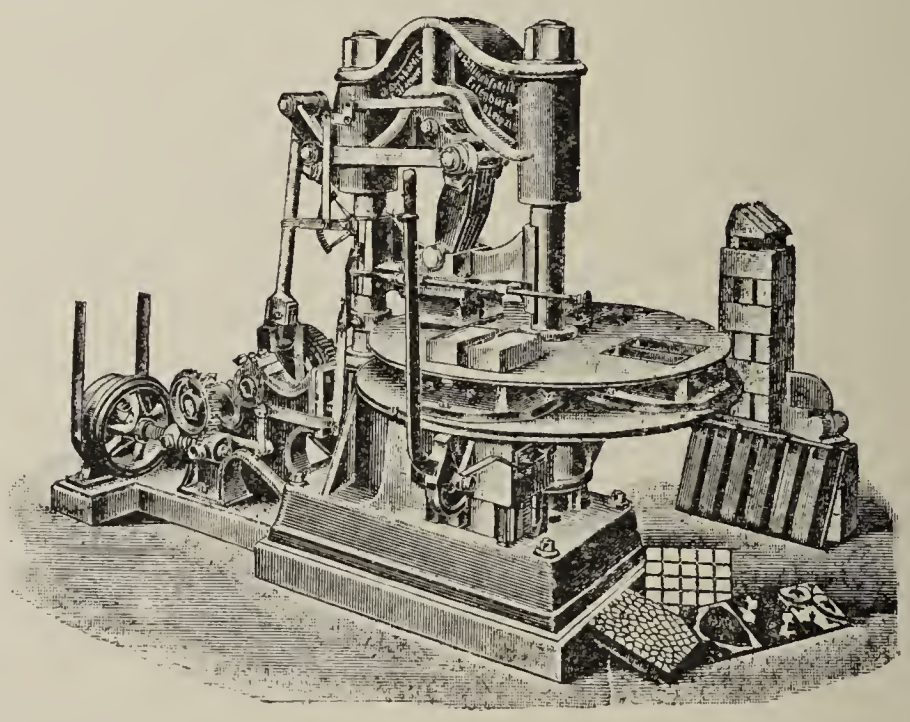
The action of sulphate of magnesia, chloride of soda, and of sea-water on the sulpho-aluminate, aluminate and silicate of lime.

The solution of chloride of magnesia, whether concentrated or dilute, rapidly destroys the sulpho-aluminate of lime, the sulphuric acid and oxide of lime passing over into the solution, leaving behind a flaky residue of alumina and magnesium hydrate, with a trace of hydrate of lime. The saturated solution of sulphate of magnesia, on account of the insolubility of the sulphate of lime, injures but slowly the sulpho-aluminate. The diluted solution of sulphate of magnesia affects the sulpho-aluminate in the same manner as the solution of chloride of magnesia. The mixed solutions of sulphate of magnesia and chloride of soda destroy the

sulpho-aluminate very rapidly. A 30 per cent solution of chloride of soda affects the sulpho-aluminate in a very energetic manner. If one places 1 gramme (15 grains) of the sulpho-aluminate into 200 cubic centimeters of the solution, it will be observed that in about twelve hours the solution has a strong alkaline reaction, and contains alumina, calcium oxide, and sulphuric acid. Sea-water affects the sulpho-aluminate very rapidly. If 1 gramme is placed into 200 cubic centimeters of the solution, it will be noticed that in about three hours the sulpho aluminate is completely destroyed, and a flaky amorphous substance is left behind, which is chiefly composed of hydrate of alumina and magnesia, with a small quantity of oxide of lime and sulphuric acid. The effect of chloride of soda upon the aluminate of lime was as follows: One gramme of aluminate was put into 200 cubic centimeters of a 30 per cent solution of chloride of soda, and allowed to stand for twelve hours; at the end of this time the solution gave a strongly alkaline reaction, and an analysis showed large quantities of alumina and oxide of lime. One gramme of the di-calcium aluminate, that is an aluminate of lime containing two equivalents of lime to one of alumina, was treated in the same manner, and gave an almost identical result. A similar analysis of the solution mixed with the tri-calcium aluminate, or an aluminate containing three equivalents of lime to one of alumina, showed however only a trace of either alumina or oxide of lime. When the tri-calcium aluminate was tested for 24 hours in sea-water, this latter was found to have become abnormally alkaline, and to contain large quantities of oxide of lime. There was, moreover a residue, which, after being washed until the chlorine ceased to react, effervesced freely on being treated with hydrochloric acid, and was found to contain a noticeable quantity of sulphuric acid a large proportion of alumina and a small quantity of the oxides of lime and magnesium. Under the microscope this residue appears as an amorphous mass, with here and there a collection of long needle-shaped crystals. If this residue is treated with hydrochloric acid until it is partly dissolved, and then examined under the microscope, it will be noticed that the needle-shaped crystals have disappeared while the mass itself has assumed a semi-transparent form. The solution is found to contain a large proportion of sulphuric acid and oxide of magnesium, together with a small quantity of oxide of lime, but no trace of alumina. The insoluble part is made up of sulphuric acid and alumina together with a very small proportion of oxide of lime. In order to justify my argument that in the presence of any of the salts found in sea-water, it was a matter of impossibility for the sulpho-aluminate to form, or for any kind of cement, especially Portland cement, containing the sulpho-aluminate, to remain uninjured when placed in contact with these salts. I made some further experiments, in which I treated the three aluminates of lime, for periods extending over several months, with (1) a solution of sulphate of magnesium, (2) a solution of chloride of magnesium, (3) a mixed solution of sulphate of magnesium and chloride of soda, (4) a mixed solution of chloride of magnesium and sulphate of lime. In each instance more or less complicated reactions were observed, but in no case was there any trace of the sulpho-aluminate of lime. By these experiments I have clearly proved that in sea-water it is impossible for sulpho-aluminate to form in any mortar compounded with cement in either high or low quantities. The same experiments have also proved beyond a doubt one very important fact which up to the present time has been neglected—namely, the destructive effect of chloride of soda upon the alumina, or aluminates contained in Portland cement, and also upon the sulpho-aluminate of lime, thereby making this cement quite unsuited for use in the construction of maritime buildings.—*Kaminiskoe Journal.*

GERMAN UNIVERSAL AUTOMATIC PRESS FOR CONCRETE FORMS.

Our illustration shows an automatic press for the manufacture of concrete specialties, such as cement roofing tile, floor tile, cement brick, lime sand brick, inlaid concrete tile with colored designs, cheap cement brick for wall backing, wainscotting and plate tiles. The press is adapted for steam, electric or hand power and consist of a frame with a central revolving shaft carrying a double disk. The materials, sand and cement being deposited on one side of the revolving disk and discharging the finished forms on the opposite side. This machine is manufactured by Dr. Bernhardi Sohn, G. E., Dranert Eilenburg near Leipzig, Germany.



GERMAN PORTLAND CEMENT EXPORTS.

Mr. Hugh Pitcairn United States consul at Hamburg, Germany, gives figures relating to the German Portland cement exports from which we abstract the following:

Portland cement exported in 1894, 796,400,000 pounds; in 1900, 1,196,778,000 pounds. From Stettin the exports have decreased from 195,115,800 pounds in 1899 to 177,390,400 pounds in 1900. Hamburg exports have increased from 645,664,580 pounds in 1899 to 674,457,960 pounds in 1900. The exports of cement from Hamburg to the United States is given as 115,381,400 pounds, the year not being designated. The exports to Australia were 70,620,000 pounds; to Brazil, 42,460,000 pounds; to Cape Colony, 37,840,000 pounds. German cements are likewise exported to the Argentine Republic, Chili and Canada, while the chief exports to European countries were to Great Britain, Norway, Spain and Portugal.

The cement exports via Bremen show a slight decrease in 1900, falling from 115,131,128 pounds in 1899 to 108,071,480 in that year. Mr. Pitcairn believes there will soon be an opening for American Portland cement in South America, Asia, Africa and Australia.

The Lupton Portland Cement Co. has suspended operations on its plant at Lupton, Mich. Operations may be resumed in the indefinite future.

THE DESIGN AND CONSTRUCTION OF A PORTLAND CEMENT PLANT.

By B. B. Lathbury,* Asso. M. A. S. C. E.

The success of a Portland cement plant depends primarily on the suitability of the raw materials, that is whether their chemical composition will produce the best cement at the lowest cost. The raw materials used for Portland cement in this country have varied during the last few years; previously the industry confined itself largely to an argillaceous limestone or to a mixture of marl and clay. Mills were afterwards erected which used limestone and clay or two grades of limestone. Later on experiments made by us with furnace slag to which was added a suitable limestone, and both burned in a rotary kiln gave a satisfactory grade of Portland cement; likewise the results obtained in our experiments with the waste at the caustic soda plant of the Michigan Alkali Co. The first problem in the erection of a cement plant is naturally therefore the investigation of the materials from both a chemical and engineering standpoint.

The samples should be carefully selected from the deposits and a complete chemical and physical investigation made covering the adaptability of the two ingredients, and the lines followed should be similar on a small scale to the process to be employed in the contemplated works. A small amount of cement should be manufactured after the chemical results of the raw materials show the proper mixture, and physical tests made from the finished cement. Accompanying these experiments and as a part of the investigation, a careful examination of the deposits should be made in order to ascertain their general conditions applied to the shipping facilities; extent of the deposits; relative location of one deposit to the other; the best process to be employed for particular conditions and requirements; the most favorable location for the plant, and also the size. These governing factors are first carefully studied and the data and results embodied in the general report, together with the recommendations upon the character of which depends the erection of the plant.

Such an investigation requires the services of engineers and chemists thoroughly skilled not only in the design and erection of Portland cement plants but also their operation. More valuable still are the services of those who have had experience in the erection of plants which have utilized various raw materials in order to accomplish the same results.

The early history of the Portland cement industry indicates that little or no attention was paid to engineering features in the construction of plants. Economy in construction and operation naturally followed what may be termed the experimental period when the commercial success of the rotary kiln was altogether problematic. The first plants were erected by experimenters and represented mere growths, as additions and extensions were made from time to time in order to improve apparent defects. Gradually, however, as the rotary process was perfected, more careful study was given the question of economy in operation and this naturally required the services of trained and skillful engineers, who had acquired intimate knowledge by their associations during the experimental period. The plants which represent tentative construction are being fast superseded by those erected from comprehensive plans and specifications in which the most minute details are carefully studied and advantage taken of local conditions. The principal requisites of a modern cement plant to-day are large capacity and low cost of manufacture, and these are only attained by careful design and construction. A cement plant can be divided into four general divisions: First, the mill proper; second, the power plant; third, the auxiliary departments; fourth, the raw material deposits and their equipment.

First, the selection and arrangement of the machinery in the mill proper depends altogether on the character of the raw materials and the general conditions to be met, surrounding the site for the plant. Mechanical devices should be used wherever possible in order to eliminate manual labor and make the process as nearly automatic as possible. Provision should be made for carrying a considerable quantity of the materials in its different stages of manufacture so that in case of a breakdown in any department, stoppage of the entire plant will not necessarily follow. All machinery and apparatus should be of simple, heavy design and the construction arranged for ready access at all times.

Second, the power plant should be so designed that a maximum saving is obtained in generating the required amount of horse power. Advantage should be taken of every refinement offered in operating the engines, which with the steam accessories should be of the most efficient type. The practice of dividing the required engine and boiler power into convenient units has been found most economical, with an excess ever ready in case of emergency.

Third, the laboratories, machine shops, cooper shops, pumping station, etc., usually classed as the auxiliary departments of a plant should be so thoroughly equipped as to render outside resources unnecessary and assist in maintaining the cost of production at a minimum.

Fourth, the equipment for operating the raw material deposits should be so adapted to the particular materials as to insure a full and constant supply at all seasons of the year, and the relative location of deposits to plant should be such that the materials are readily accessible and quickly transported by short hauls to the grinding and mixing departments. Machinery for transporting the materials to the mill should operate at the lowest cost and meet the peculiar requirements of the materials themselves.

These four sub-divisions are each dependent on the other in order to make up a composite whole, which represents the plant. But each division performing certain independent functions is again divided into the main departments of manufacture.

The general design and arrangement of these departments depend largely on local conditions and the amount of money to be spent in constructing the plant. Long experience, however, has demonstrated that the very heaviest and best machinery is none too good in a Portland cement plant, and if a saving is necessary, it should be effected on the buildings and not at the expense of the mechanical equipment, as the wear and tear in this particular line of manufacture is probably greater than in any other industrial enterprise. The constant and steady operation of the different machines which generally speaking are operated nearer 24 hours than 10 or 12 hours, render impossible extensive repairs without causing a shut down to the whole plant; and thus it is that Portland cement works require a complete overhauling once each year.

While the foregoing shows the importance of entrusting the design to skillful hands, it is just as necessary to the ultimate success of the plant that the construction should be supervised by the same parties. The success of many an enterprise is endangered by incorrect interpretation of specifications and design, and this is especially true in the erection of a cement plant. The necessary care and vigilance of parties familiar with both the design and operation is continually required during its course of erection and until the plant is ready to operate, after which follows the most critical period in the life time of a plant. From the time the various departments are set in operation, until the entire plant is run-

*Lathbury & Spackman, Engineers, Philadelphia.

ning smoothly and successfully, the direction should be entrusted absolutely and entirely to experienced hands. Unfortunately the converse of this has been true in a large number of plants erected in this country during the past few years by capitalists without the first knowledge of their operation. In these instances they became incapacitated in a few months and required rebuilding, thus doubling the first cost of construction and entailing a heavy loss to the investors.

A plant to be successful should be designed and constructed by experienced engineers and afterwards operated under their management until in successful running order, then turned over to skillful operators who have become thoroughly familiar with the process and machinery employed.

CEMENT WORKS BURNED.

A large portion of the Alma Portland cement works at South Wellston, O., was destroyed by fire on November 5th. The plant was one of the first constructed in southern Ohio. Messrs. Lathbury & Spackman of Philadelphia, Pa., were the largest holders of stock in the company. The loss will exceed $80,000. The plant will be rebuilt on a larger scale.

The following line of insurance was carried on the plant:

Liverpool & London & Globe	$6,500
Phenix, Brooklyn	6,500
Ohio Farmers'	5,000
Hartford	4,000
Columbia, Ohio	3,000
New York Under. Agency	2,500
Imperial	2,500
Ins. Co. of North America	2,500
National, Conn	2,500
Providence-Washington	2,500
Connecticut	2,500
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Springfield	2,000
Traders	2,000
Michigan	2,000
Citizens' Mo	1,500
Citizens' N. Y	1,500
Lafayette	1,500
Western, Pa	1,000
Cooper, Ohio	1,000
County of Pa	1,000
National, Ohio	1,000

The Central Asphalt & Refining Co. of Chicago will erect a large asphalt and oil refining plant at South Beaumont, Tex., with a branch refinery at Port Arthur, Tex. All foundations for both plants will be constructed of shell, sand and concrete. Robert Kuntsman, C. E., 84 Adams street is preparing the plans for both works. The company has strong financial backing and will invest about $2,000,000 in the enterprise.

Messrs. Cady & Howson of Comanche, Ia., have opened a cement sidewalk and tile factory.

The Omega Portland Cement works closed Saturday, November 11, for want of storage room for clinkers.

Granitoid and Cement Workers' Union, East St. Louis; incorporators, Dennis Shea, Michael Arnest and Stephen Shea.

Hudson, N. Y., is offering a bonus to induce a cement plant to locate within its corporate limits. Over $4,000 has been subscribed for this purpose.

Incorporated: Midland Portland Cement Co., authorized capitalization $1,000,000; New Jersey agent, Corporation Trust Co., 15 Exchange place, Jersey City.

The Capital Portland Cement Co. of Stewartsville, N. J., has options on six farms near Stewartsville station, comprising about 800 acres at prices ranging from $150 to $250 per acre.

The works of the Alabaster Co., cement and plaster manufacturers, at One Hundred and Third street and Commercial avenue, South Chicago, were partially destroyed by fire on Nov. 2d.

E. B. Turner of Winnetka, a suburb of Chicago, will erect a concrete dwelling after the Edison plan, in which all walls and partitions will be poured into forms erected on the building site.

John T. Brush of Indianapolis, Ind., has let the contract for erecting the grand stand at the Indianapolis base ball grounds. The entire structure will be concrete including roof and rafters.

The White Star Portland Cement Co. filed articles of incorporation with the Wayne circuit court at Detroit, Mich.; capital stock $10,000; incorporators, L. C. Waldo, W. M. Hull and E. W. Sprague.

The cement shipments from the central mills of the Atlas Co. at Northampton, Nov. 1st, amounted to 21,400 barrels. To move this amount of cement required over 200 cars—a solid train a mile and a half long.

The Alpha Portland Cement Co. is reported to have purchased 16½ acres of land containing lime stone deposits in Derry township, Dauphin county, Pa., through its agent, S. P. Light of Lebanon, Pa. The consideration being $29,000.

The Southern Cement Co. of Birmingham, Ala., has placed the "Alabama brand Portland cement" and "Magnolia brand hydraulic cement" on the market. The mill started up on March 1st last, the entire output is sold without difficulty.

Chas. L. Johnson of New York, president of the Detroit Portland Cement Co., died at his home in New York on October 8th.

Concrete Foreman Wanted.—D. A. Crage & Co., Akin, N. Y., want a first-class concrete foreman for three months work. References required.

Incorporated: John T. Sawyer Co. of New York City, to deal in lumber, cement and ship building materials; capital $100,000; directors, J. T. Sawyer and J. L. Watrous of Key West, Fla., and H. H. Gibbs of New York City.

The Pere Marquette Ry. of Michigan is constructing concrete bridges on its line. Two bridges with 22-feet spans each have just been finished in this material near Northville, Mich., after the plans of G. H. Kimball, chief engineer of the company.

The Business Mens' Club of Ludlow, Ky., just south of Cincinnati, claim to have perfected an organization for the construction of a Portland cement plant to be located two miles south of Ludlow on the Queen & Crescent route at a point known as Dolan's Dump, Ky.

The electrical high speed trials on the German experimental railway between Berlin and Zassen are now under way, 84 miles per hour has been attained with comparative ease, using only four-sevenths of the energy available. The speed of the train is gradually being increased. It is fully expected that 125 miles per hour will be made before the experiments are completed.

Star & Brigham of Battle Creek, Mich., have just closed up the options on the extensive marl deposits at Fish lake near Orangeville, Mich., one mile east of the village. The marl is of superior quality, 98 per cent pure. Mr. Brigham has gone to New York to confer with the company. A spur railroad will be built from Neeley's on the Cincinnati & Northern to the deposit.

A 16 page pamphlet entitled "A Short Railway Story" is now being sent out by Arthur Koppel of 66–68 Broad street, New York City. It is nicely gotten up and is a treatise on narrow gauge railway materials. It emphasizes the advantages to be derived from contracting for complete outfits with one firm. This pamphlet shows one or two designs in the leading lines of his manufacture giving a general idea of the varied products manufactured by this firm. Anyone interested in narrow gauge railways for mines or industrial plants will receive a copy on request and will find it of special interest.

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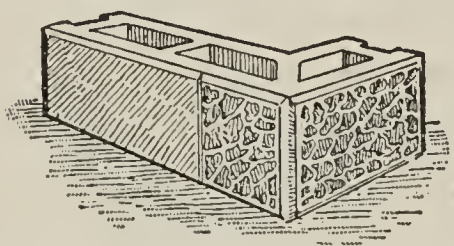

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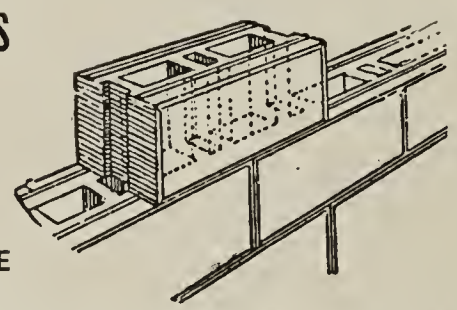

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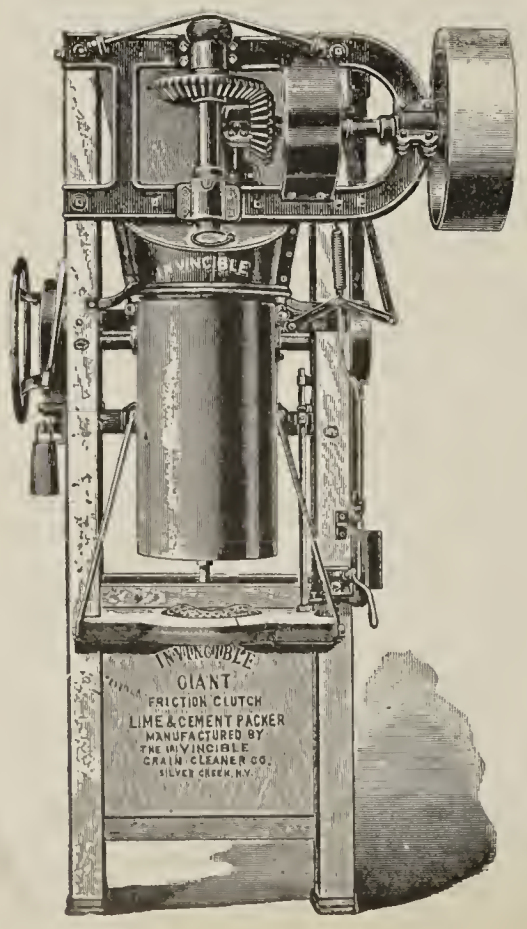

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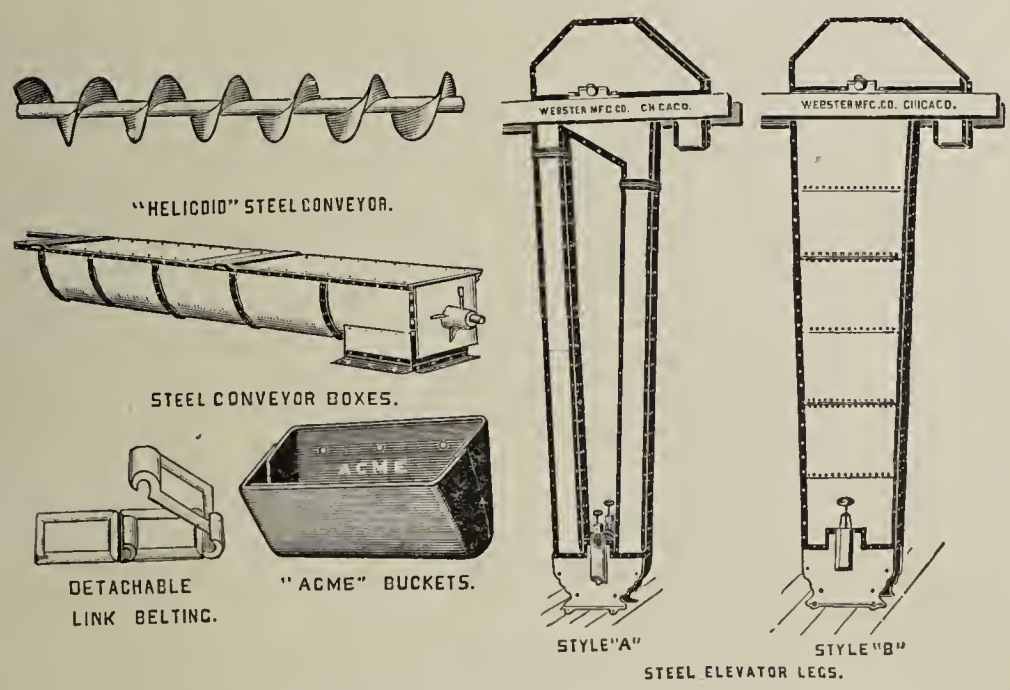

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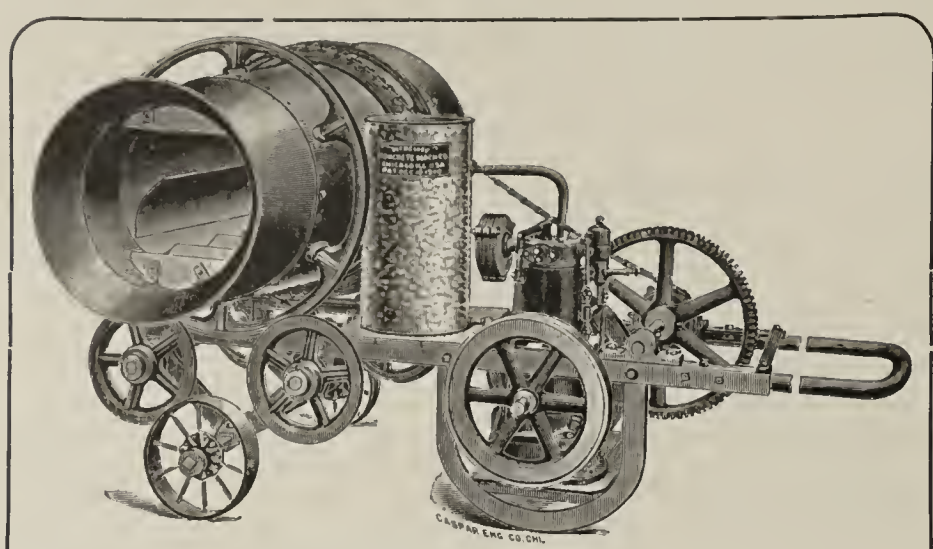

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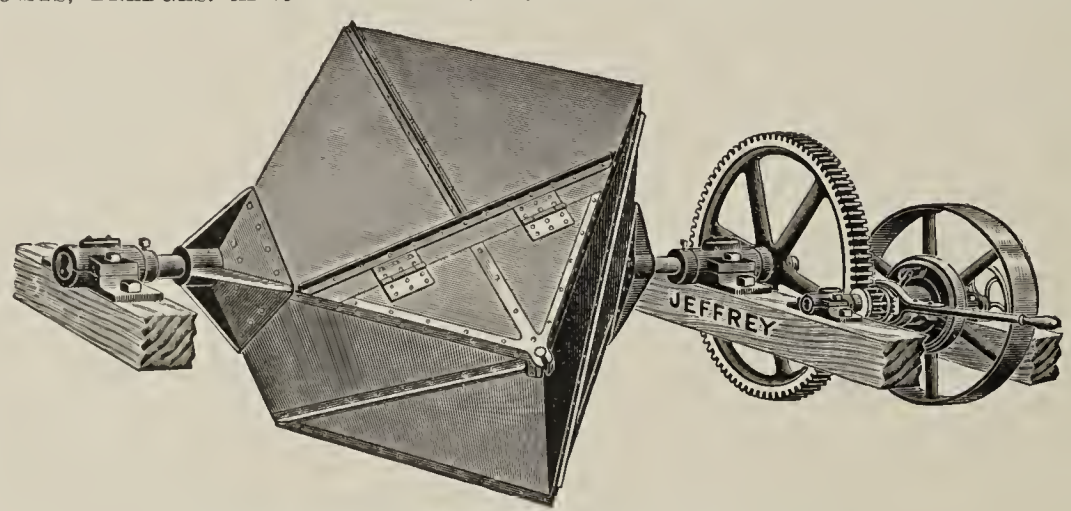

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The Chicago, Milwaukee & St. Paul Railway Company owns 6,168 miles of railway, exclusive of second track, connecting track or sidings. The eight States traversed by the Company, Illinois, Wisconsin, Northern Michigan, Iowa, Missouri, Minnesota, South Dakota and North Dakota, possess, in addition to the advantages of raw material and proximity to markets, that which is the prime factor in the industrial success of a territory—a people who form one live and thriving community of business men, in whose midst it is safe and profitable to settle.

A number of new factories and industries have been induced to locate—largely through the instrumentality of this Company—at points along its lines. The central position of the States traversed by the Chicago, Milwaukee & St. Paul Railway makes it possible to command all the markets of the United States. The trend of manufacturing is westward. Confidential inquiries are treated as such. The information furnished a particular industry is reliable.

Address,

LUIS JACKSON,
Industrial Commissioner, C. M. & St. P. Ry.
435 Old Colony Bldg., Chicago, Ill.

CEMENT
.....AND.....
ENGINEERING NEWS

THE NEW MILL OF THE ALPHA PORTLAND CEMENT CO., PHILLIPSBURG, N. J.

McKelvy & Hine, Contractors, Pittsburgh, Pa.

The building is 234 ft. long by 100 ft. wide; the concrete walls are 4 ft. 9 ins. thick at the base and battened on the outside to 18 ins. at the top. The concrete work extends 15 ft. above the floor level. The floor is likewise of concrete. All of the concrete was mixed by one McKelvey push cart power mixer.

CEMENT AND ENGINEERING NEWS.

(PUBLISHED MONTHLY)

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ADVERTISING RATES SENT ON APPLICATION.

"This world belongs to the energetic."

This paper is a member of the Chicago Trade Press Association.

Chicago, December, 1901.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all of its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experience will be welcome.

THE AMERICAN PORTLAND CEMENT TRADE.

The remarkable growth of the American Portland cement industry is made apparent by the sales during the present year, which we have computed at not less than 15,000,000 barrels, based upon the output of the American mills, ten month's run being assigned to the mills working on rock and eight month s run for mills using marl. Our estimate for each individual mill is much less than the claims made by the manufacturers themselves.

The sharp and unlooked-for decline in the price of Portland cement has not affected the output, except the shutting down of three small mills, one in the East and two in the Middle West. Portland cement manufacture in the United States is now in the hands of large corporations sustained by an abundance of capital and experience which enables them to produce at a minimum of cost, resulting in placing the small producers at a disadvantage when they have to compete with the larger producers. This is especially true of the marl plants which are compelled to use from 50 to 70 per cent of water in their finished slurry as it enters the rotary kiln, calling for a larger percentage of fuel per barrel of cement produced than mills working the dry process. At the same time the wet marl slurry process, as it advances in the kiln towards the heat zone, where incipient clinker is formed, cannot be forced as in the dry process used where rock is the raw material, and results in a restricted output under the wet process, the average being 125 barrels per rotary as against 200 to 225 barrels on the dry process.

We concede that in both the wet and dry process the figures here given have been exceeded on trial runs per kiln, therefore the marl process must be improved to successfully compete with the rock process wherever the rotary kiln is used. The Star-Stettin Works in Germany have apparently solved the economic manufacture of Portland cement on the wet process, using as high as 70 per cent of water in the finished slurry, nevertheless have been able to clinker 240 barrels per rotary in 24 hours.

No combination of cement manufacturers using the wet process can, by simply spreading its behests upon its journals, reduce the cost of manufacture and increase the output of their mills. The remedy lies alone with the individual mill owners who must work out their own salvation in the face of the serious competition which confronts them.

Michigan leads all other states in the number of new plants projected and erected during the year. California and the Pacific Coast for the first time has several Portland cement mills under way. The consumption on the coast is large and has heretofore been supplied by one mill and by imports from abroad, including China. We notice a prediction that the Pacific Coast cement mills would eventually secure a large Japanese and Chinese market. The facts are quite otherwise. The eight large mills in Japan and two in China are abundantly able to take care of the trade of the two companies named. The progressive ideas of the Japanese and the condition of the labor market in that country and the extremely rapid development of Japanese cement mills will be abundantly able to take care of the cement trade in the Orient without fear of serious American competition.

The Alpena Portland Cement Co. has shut down. The plant will be enlarged.

Incorporated: The American Portland Cement Company of Pierre, S. D. Capital, $1,000,000. Incorporators D. W. Splane, A. G. Thompson, G. W. Sanders.

The Iola Portland Cement Co. has elected the following officers: S. H. Basset, president; A. I. McLeod, vice-president; John T. Holmes, secretary and treasurer; directors, S. H. Bassett of St. Louis, E. H. Ryan of Davenport, Ia., and John T. Holmes of Detroit for three years; W. H. Doty of Davenport, Ia., Wm. Lossler of Pittsburg and Alex. McLeod of Detroit for two years; Wm. Childs of Calumet, J. D. Curtis of Ludlow and James Bayles for one year.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM.	OCTOBER.				TEN MONTHS ENDING OCTOBER.			
	1900.		1901.		1900.		1901.	
	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.	QUANTITY IN LBS.	VALUE IN DOLLARS.
United Kingdom....	777,800	2,953	8,108,800	32,062	86,261,547	336,579	9,915,681	39,102
Belgium..	51,613,021	162,194	19,953,548	63,330	265,159,843	796,078	92,681,076	282,992
France	.....	.....	1,269	22	11,713,088	41,880	4,689,591	19,729
Germany.....	48,122,116	176,521	23,722,421	82,247	404,934,508	1,515,005	177,885,882	630,934
All Other Europe ...	3,162,400	8,188	198,400	651	28,758,817	87,744	7,432,763	20,079
British North Am...	599,846	2,931	178,500	774	1,774,536	9,197	1,586,497	7,122
Other Countries.....	400,000	1,666	.....	.....	9,547,680	41,415	2,717,071	11,525
TOTAL	104,676,183	354,453	52,162,938	179,086	808,150,019	2,827,898	296,908,561	1,011,483
Domestic Exports of Cements, bbls.	8,750	19,073	47,704	76,225	64,306	142,397	323,470	588,999

There were 14,657,658 lbs. of imported Roman and Portland cements, etc., in the United States bonded warehouses on October 31, 1900, valued at $49,145, against 10,640,543 lbs., valued at $34,289 on October 30, 1901.

Imports of asphaltum or bitumen for October, 1900, were 9,530 tons valued at $24,213; October, 1901—5,527 tons valued at $25,750. For ten months ending October, 1900, 95,796 tons valued at $333,683; for ten months ending October, 1901—115,378 tons valued at $429,894.

DEVICES FOR RAPIDLY CALCULATING THE CORRECT COMPOSITION OF CEMENT MIXTURE.

By Richard K. Meade.

In the manufacture of Portland cement nothing is left to guess work. The raw materials are carefully analysed and proportioned according to the result of the analyses, so as to give the best cement when burned. The rapid schemes for the determination of silica, lime and alumina have enabled the chemist to quickly arrive at the composition of his clay, limestone or cement rock and the following devises should enable the cement maker to calculate from its analysis in a minimum of time the proper proportion of each of these in a good cement mixture.

Newberry proposed the following ratio for the lime, silica and alumina in Portland cement:

Lime = 2.8 × % Silica + 1.1 × % Alumina.

Some manufacturers contend that, while theoretically this may be true, in practice an overlimed cement would result if the exact ratio were adhered to. However, this may be, his formula will serve to illustrate the following table and devise for calculating the cement mixture with any given materials. The substitution of any given ratio for the one above will of course be easy. Let us suppose that we have found by experience that Newberry's formula gives a correct cement mixture. Now carbonate of lime = lime × 1.79 from which Newberry's formula becomes

Carbonate of Lime = 5 × % Silica + 2 × % Alumina.

To find out how much carbonate of lime is required for mixing with a certain cement rock to make good cement, it is only necessary to multiply the percentage of silica by 5, the percentage of alumina by 2, add the two products and deduct the percentage of calcium carbonate already present in the cement rock, the difference will be the number of pounds of pure calcium carbonate necessary to mix with 100 pounds of the cement rock to make a cement in which

Lime = 2.8 × % Silica + 1.1 × % Alumina.

The table for saving the multiplication in this calculation is shown in Fig. 1. It is made of cross section or co-ordinate paper, such as can be bought by the sheet or yard from any dealer in draughtsman's supplies. The paper ruled in squares every centimeter with broad lines and these spaces divided again into tenths by fine lines is best for this use. A sheet of this of sufficient size to cover all raw material used in the particular plant is either pasted to a sheet of stiff card board or tacked to a drawing board. After drying, the large divisions on the lower margin are numbered 1, 2, 3, etc., to correspond to the percentages of silica and alumina in the clay, while the divisions of the same size on the right and left hand margins are numbered 5, 10, 15, etc., to correspond to pounds of calcium carbonate. Now two lines are drawn, one making an angle of 45° with the horizontal margin and passing through the o, o point, the other passing through the same o, o point but making an angle of 21°, 48′. The first line represents the "calcium carbonate-silica" ratio and should be so designated, the second the "calcium carbonate-alumina" ratio. The abscissas (figures on the lower margin) of points on the cal-

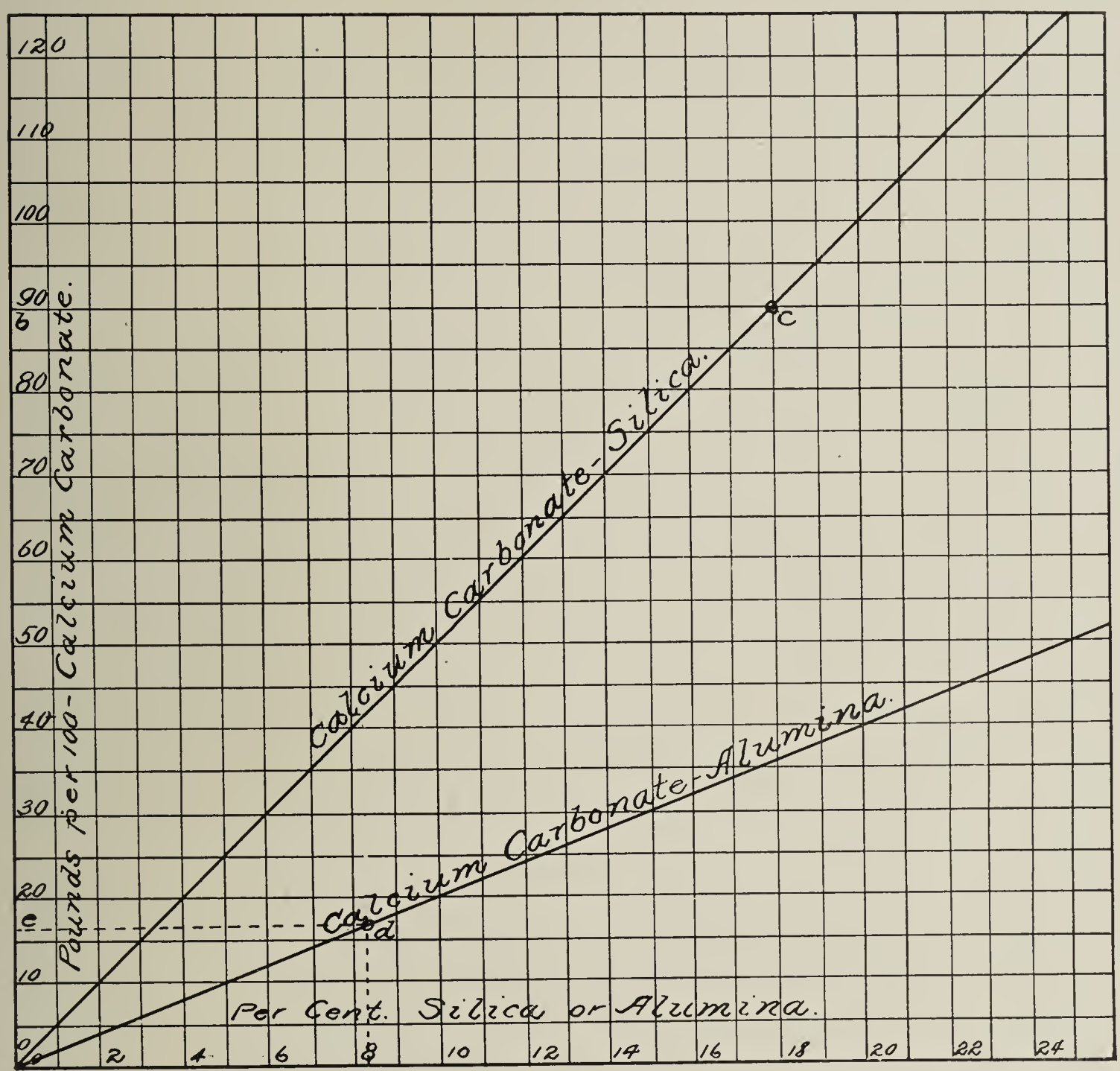


FIG. 1.

cium carbonate-alumina line represent the percentage of silica in the cement rock and the ordinates (figures on the side margins) the corresponding weight of calcium carbonate. Similarly the abscissas of points on the calcium carbonate-alumina line express the percentage of alumina and the ordinates of these points the corresponding weight of calcium carbonate. As an example, to explain the use of the table, suppose we wish to know how much calcium carbonate to mix with a rock of the composition:

Silica	18.0	per cent.
Alumina, etc.	8.3	"
Calcium carbonate	67.3	"
Other constituents	5.9	"
	100.00	

First find the calcium carbonate equivalent to the silica in the stone. To do this run up the vertical line corresponding to 18 to "*c*" where it cuts the line marked "calcium carbonate silica." The ordinate "*b*" of this point, (found by running along the nearest horizontal line to "*c*" to the margin) or 90, will be the weight of calcium carbonate equivalent to the silica. Next find the calcium carbonate required for the alumina by running up the vertical line corresponding to 8.3 to "*d*" where it cuts the line marked "calcium carbonate-alumina" and then along the nearest horizontal line to this point to the side margin. The reading here "*e*" or 16.6 will be the weight of calcium carbonate required for the alumina. The silica and alumina together of course will require 16.6 + 90 or 106.6 pounds of calcium carbonate, but since the cement rock contains 67.3 per cent calcium carbonate it is only necessary to add to it 106.6 — 67.3 or 39.3 pounds of calcium carbonate.

It is not necessary to use a protractor in drawing the "calcium carbonate-alumina" and the "calcium carbonate-silica" lines. It is evident that both lines must pass through the o, o point. Any other point through which they must pass may be quickly found by calculation and the lines drawn through these two points. For example 25 per cent silica will require 25x5 or 125 pounds of calcium carbonate. So if the line "calcium carbonate-silica" is drawn through the o, o point and the point of intersection between the vertical line corresponding to 25 per cent silica and the horizontal line corresponding to 125 pounds of calcium carbonate, it will have the proper angle. Similarly the alumina line should be drawn through the o, o point and that of the intersection of the vertical line corresponding to 25% alumina and the horizontal line corresponding to 25x2 or 50 lbs. of calcium carbonate.

The substitution of any other lime-silica and alumina ratio than that represented by Newberry's formula can easily be effected. For example let us suppose that in a given plant Newberry's formula gives an "overlimed" cement, and that a formula

Calcium carbonate = % silica × 4.9 + % alumina × 1.96

gives better results. Then in order to express this ratio it is necessary to draw the silica line through the o, o point and the point of intersection of the vertical line representing 25% silica and the horizontal line representing 25x4.9 or 122.5 pounds calcium carbonate. The alumina line is drawn through the o, o point and that of the intersection of the vertical line representing 25% alumina and of the horizontal line 25x1.96 or 49.0 pounds calcium carbonate.

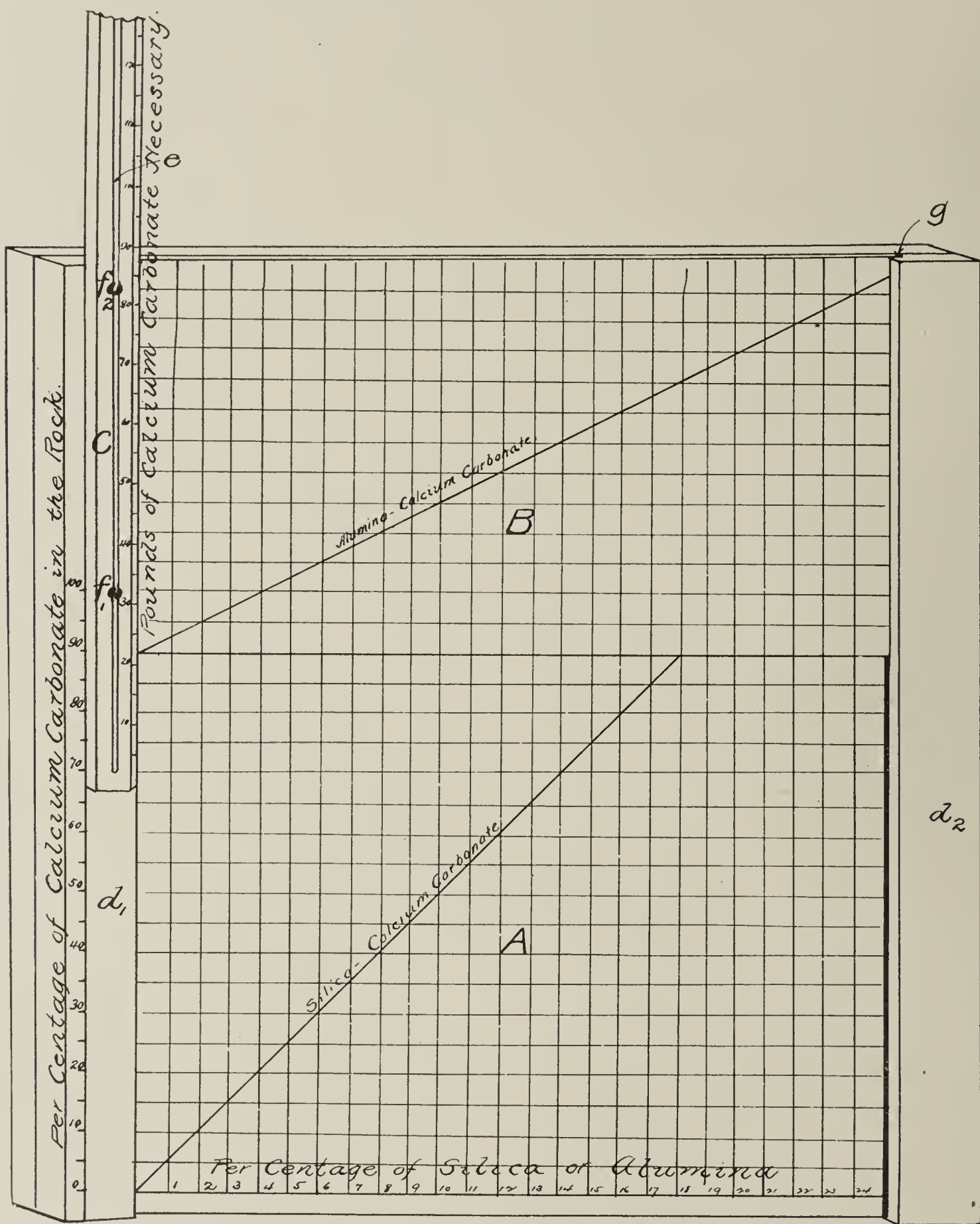


FIG. 2.

Nothing will be gained by having the larger divisions of the co-ordinate paper represent less than one per cent silica or alumina and five pounds of calcium carbonate, since the small spaces will then represent 0.1 per cent and technical determinations of lime, silica and alumina are seldom nearer the truth than this. This will keep the tables well down in size. When used with clays high in silica space can be saved by having two tables—one ranging say from 10–25% and serving for the alumina in the clay and the alumina and silica in the marl, the other ranging say from 45 to 60% for the silica in the clay. In these tables two points must of course be determined. In the first the silica line would of course pass through the point of intersection of the vertical and horizontal lines representing 10% silica and 10x5 or 50 pounds calcium carbonate, respectively, and the point of intersection of the vertical and horizontal lines representing 25% silica and 25x5 or 125 pounds of calcium carbonate, respectively. While in the second table it would pass through the points of intersection of the vertical line representing 45% silica and the horizontal line representing 45x5 or 225 pounds of calcium carbonate, and of the vertical line corresponding to 60% silica and the horizontal line corresponding to 60x5 or 300 pounds calcium carbonate.

The lines may of course be drawn to represent the lime, calcium oxid, required; in which event the main vertical divisions should be numbered 2, 4, etc., and have twice the value of the spaces on the horizontal margin. The silica line would in this event be drawn through the o, o point and the point of intersection of the vertical line corresponding to 25% silica and the horizontal line corresponding to 25x2.8 or 70 pounds calcium oxid.

Fig. 2 shows an apparatus, designed upon the same principle as the tables, which does, not only the multiplication, but also the addition and subtraction of this calculation. It is simple and can easily be made with the help of a carpenter. The device consists of a thick board A of size to suit the co-ordinate paper. The one pictured is 14½x16 inches. The co-ordinate paper is ruled with fine lines every $\frac{1}{20}$ inch, a shade broader lines every ¼ inch and broad lines every ½ inch. It has a range of from 0 to 25 per cent silica or alumina. At each edge of the board A are fastened strips d_1 d_2 grooved on the inside to allow a thin board to slide freely, but with none or very little side play, over the face of the base board A. The left hand strip has its face sloped towards the base board on the inside so as to meet the surface of the sliding board. On this sloping edge a scale "C" slides freely up and down, held in place by two screws f_1 and f_2 working in a slot "e." Upon the base board A is pasted down the co-ordinate paper mentioned above, ruled with the silica-calcium carbonate line as in the above table. The co-ordinate paper with the alumina-calcium carbonate line is pasted down upon the sliding board B. Its o horizontal line should coincide with the edge of the sliding board. This latter edge should of course be straight and parallel to the horizontal rulings on the base board. The co-ordinate paper should be pasted on the sliding board so that the vertical lines are a continuation of those on the base board. They should also be parallel to the sliding scale C. This sliding scale and the fixed scale on the strip d_1 should be laid off on the same scale as the co-ordinate paper. Indeed the easiest way to make these scales is to cut two strips of co-ordinate paper and paste down. The scale on the sliding rule C should have its zero point coincident with the lower end of the slide. That on the side piece d_1 should have its zero on a line with the bottom line of the base board. The large spaces on the lower margin of base board should be numbered 1, 2, 3, 4, etc., to correspond to the percentage of silica and alumina; and those of equal size on the sliding rule and side piece should be numbered 5, 10, 15, 20, etc., and correspond to pounds of calcium car-

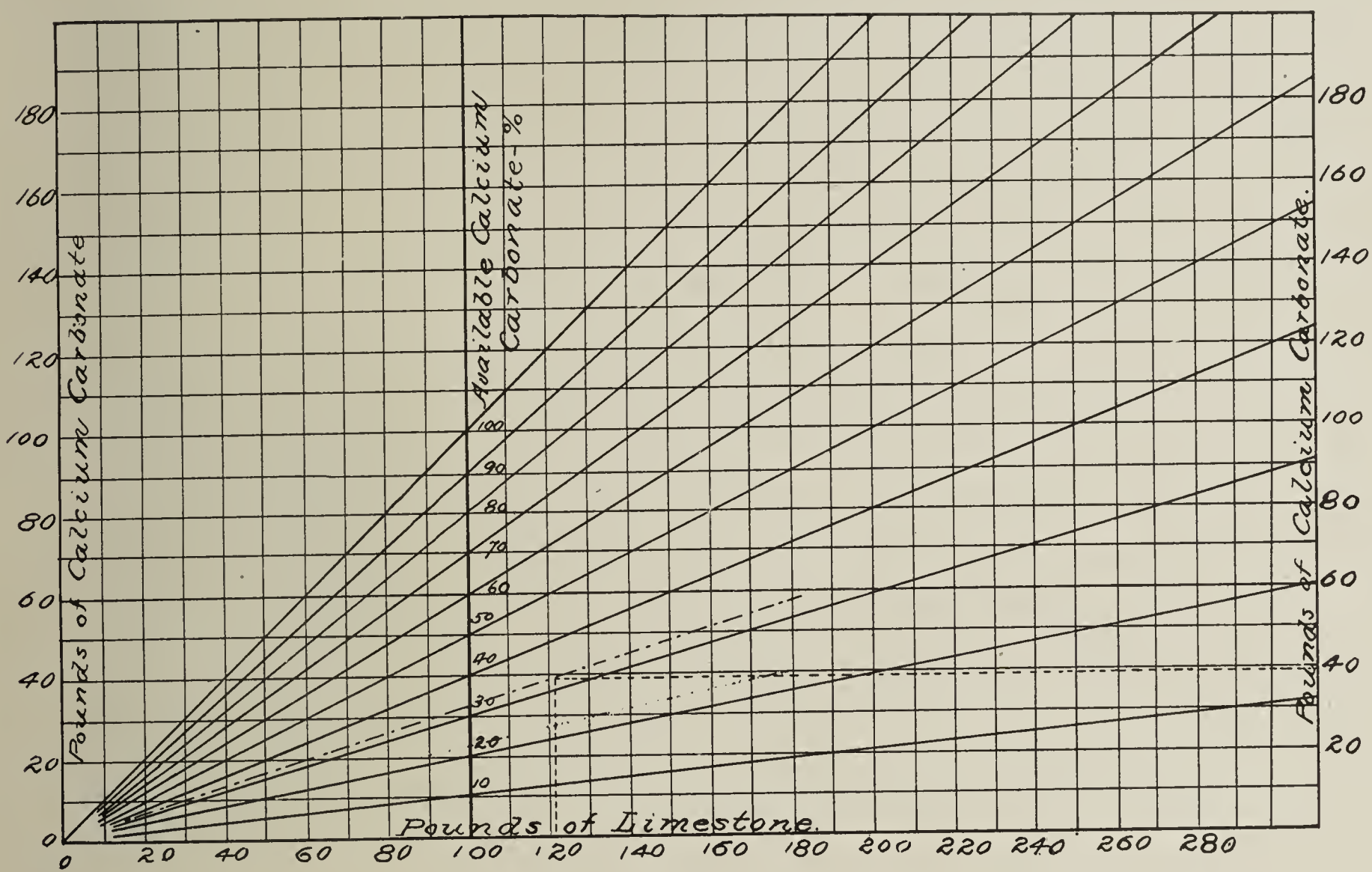


FIG. 3.

bonate per 100 pounds of cement rock and percentage of calcium carbonate in the rock, respectively.

To use the apparatus, set the sliding board *B* where its lower edge passes through the point of intersection of the silica percentage line and the silica-calcium carbonate line. Set the sliding scale *C* so its lower end is opposite the figure on the scale to its left corresponding to the percentage of calcium carbonate in the rock. Now to find the calcium carbonate necessary for 100 pounds of cement rock, glance up the vertical line corresponding to the percentage of alumina to where it cuts the alumina-calcium carbonate line and then along the nearest horizontal line to this point to the margin. The reading on the sliding scale at this point gives the calcium carbonate to be added. For example in the rock given above there is 18% silica. Set the sliding board *B* so its edge is just above the point where the vertical line 18 cuts the silica-calcium carbonate line. Then set the sliding scale so its lower edge is opposite 67.3 on the fixed scale to its left (67.3 = % calcium carbonate in the rock). Now glance up the vertical line 8.3 (= % alumina) to where it cuts the alumina-calcium carbonate line on the sliding board and then, along the nearest horizontal line, to the margin. The reading 39.3 here on the scale gives the calcium carbonate which must be added to 100 pounds of rock to make a good cement.

Limestone is never pure calcium carbonate and always contains some clayey matter. Part of the calcium carbonate it contains is therefore used in converting its silica and alumina to silicate and aluminate of calcium, respectively. Suppose a limestone has the composition

Calcium carbonate	87.0	per cent.
Alumina	3.5	"
Silica	9.5	"

Now using either the above table or calculating, the silica will require 47.5 pounds of calcium carbonate and the alumina 7 pounds of calcium carbonate and the two together 54.5 pounds per 100 pounds of limestone. Consequently in 100 pounds of limestone only 87.0 — 54.5 or 32.5 pounds of calcium carbonate are available for converting the silica and alumina of the cement rock to cement. If we desire to know how much of the limestone to mix with 100 pounds of the cement rock we must use the proportion

32.5: 100:: 39.3: weight of limestone required.

From which, weight of limestone

$$= \frac{100 \times 39.3}{32.5} = 120.9 \text{ pounds.}$$

This calculation also may be saved by the use of co-ordinate paper. A large piece (Fig. 3) is fastened to a board and the main divisions on the lower margin are numbered 10, 20, 30, 40, etc., to correspond to pounds of limestone. Those on the right and left hand margins are numbered 10, 20, 30, 40, etc., and represent pounds of calcium carbonate required for the cement rock. On the vertical line 100, the main divisions are numbered 10, 20, 30, etc., to represent pound per 100 or percentage of *available* calcium carbonate in the limestone.

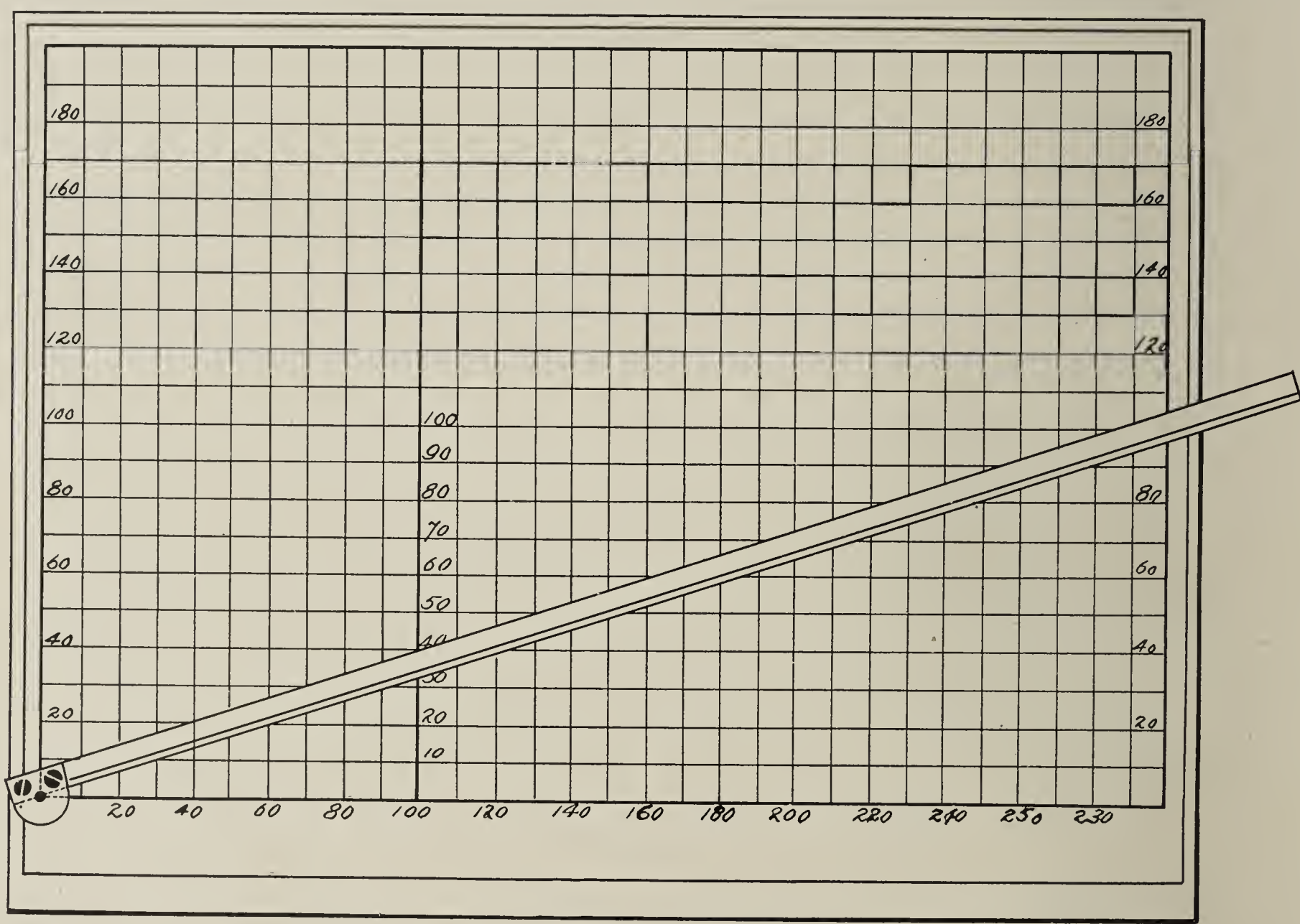


FIG. 4.

Now thick lines are drawn through each of these main spaces on the 100 line and thin lines through each of the small spaces. Points on each line whose ordinates are the required pounds of calcium carbonate will have for abscissa the corresponding number of pounds of limestone. So that to find the number of pounds of limestone equivalent to a given weight of calcium carbonate, glance along the horizontal line corresponding to the quantity of pure calcium carbonate required until it meets the diagonal line, intersecting the 100 vertical line at the percentage of

available calcium carbonate, and then down the nearest vertical line. The reading at the lower margin will give the weight of limestone. For example, using the table, we wish to know how much of the limestone (containing 32.5 pounds available $CaCO_3$), whose analysis is given above, is required for the cement rock that requires 39.3 pounds calcium carbonate. Run the eye along the horizontal line corresponding to 39.3 to where it cuts the diagonal line which passes the 100 vertical line at 32 (or 33), and then down the nearest vertical line to the margin, the reading here, or 121, will be the weight of limestone needed. Of course it will, in the above example, be easy to suppose that an imaginary line passes the 100 vertical line at 32.5 and use it in place of the 32 or 33 line. The table in a better form is shown in Fig. 4. In place of a large number of diagonal lines there is a ruler fixed so as to turn about the o, o point. It is only necessary to set the edge of the ruler at the point on the 100 vertical line (This line is in the drawing made broad but it would be better to rule over it or to one side in red ink.) representing the percentage of *available* calcium carbonate in the limestone. The edge of the rule is then used similarly to the drawn diagonal lines. It is hardly necessary to remark that the pivot around which the rule moves must be on a line with the edge of the ruler.

The writer will be pleased to explain by letter to those who may be interested any points not made clear in this paper.

The Newaygo Portland Cement Co. will manufacture its own barrels in the near future.

The Hecla Cement Co. will construct dykes around its mill site near the mouth of Saginaw river. The land being subject to overflow during the spring freshets. The contract for the work has been let to the Davidson Dredging Co. of Bay City.

The property of the Cassadaga Cement Co. of Cassadaga, Chautauqua county, N. Y., was attached by Deputy Sheriff W. E. Clark on claims for wages due employes. Superintendent Jensen was one of the employes bringing the suit.

A new asphalt company was organized at Syracuse, N. Y., in November by local and outside capitalists. It is proposed to make the company one of the biggest of its kind in the United States. John Dunfee and Senator Horace White are among the Syracuse capitalists interested. Mr. Dunfee is financing the construction of the Boston subway.

MOND PRODUCER GAS FOR CEMENT MILLS.

In the issue of CEMENT AND ENGINEERING NEWS for August, 1901, considerable comment is made on the possibilities of Mond producer gas for Portland cement manufacturers.

The article, while correct as far as it relates to British coal, does not necessarily apply to American coal, in all details.

It has been the writer's advantage to have studied and worked in the only Mond producer plants in existence, one in Brunner, Mond & Co.'s alkali plant at Winnington, England, the other at an alkali plant in Michigan.

In England slack coal has been found which is high in ammonia producing elements and which will also work satisfactorily in the producer.

In this country, sizes smaller than pea coal make too much trouble to be used. The difference in cost between pea and slack coal is a serious matter. Mond gas, as it comes from the producer plant, after treatment to remove by products, is a lean gas, high in moisture.

The following table will show the relative composition by volume and heating capacity of dry Mond gas and natural gas from Muncie, Ind.

	MOND GAS	NATURAL GAS
H	23 %	2.35%
CO	11 %	.45%
CH_4	4 %	92.67%
CO_2	15.5%	.25%
O	.5%	.35%
N	46 %	3.53%
Calories per cubic meter	1,447	9,477

Thus one cubic meter of American natural gas has the heating effect of nearly seven of Mond gas. Experiments made by the writer with Mond gas from American coal, burning it in rotary kilns with air heated to 480° F. by economizers, and 2% only of excess oxygen showing in the chimney gas, showed the temperature of combustion to be about 1,300° F.

A temperature of about 2,700° F. is needed for burning cement clinker and is readily obtained with natural gas. To use Mond gas for cement kilns, it would be necessary to pass both the gas and air through heaters of the proper design to ensure a high enough temperature of combustion to burn the clinker. For the power house of a cement factory Mond gas could be burned, without farther treatment, in gas engines direct-connected to electric generators, thus eliminating expense of a boiler plant entirely.

Mond gas has been made in this country on a practical scale, in a plant handling 150 tons of coal, so successfully that the by products recovered have not only paid for labor, repairs and chemicals required, but have actually sufficed to reduce the price of coal some 50 cents a ton, to the manufacturer, and to make the cost of the gas about 1c per thousand.

However, as a Mond producer plant cannot be economically handled unless using 100 tons or more of coal per diem, and as 1½ pounds of coal at the producers will yield one I. H. P. per hour in a gas engine, it is evident that nothing less than a 6,000 H. P. power plant would justify erection of a Mond producer plant, or that no cement mill of less than 6,000 barrels capacity should use such a plant unless arrangements were made to burn the gas in rotary kilns also. In the latter event, a 3,000 barrel plant might justify the erection of a Mond producer plant.

The greatest field in this country for Mond producer plants will be to supply fuel gas for gas engines in the large electric power plants that must eventually come with the extension and consolidation of our electric railway systems and lighting systems.

M. M. GREEN,
Consulting Engineer.
DETROIT, MICH.

The Atlas Portland Cement Co. has been operating a steam sand pumping boat on the Mississippi river at Hannibal, all of the sand required in the construction of its plant at that point being obtained in this way.

Buffalo, N. N., parties have been prospecting on the farm of Wm. P. Bonnel near Belvidere, Warren county, N. J., for cement rock with the view of erecting a Portland cement plant thereon. Large deposits of suitable cement rock have been found. The matter is now in the hands of experts employed by the prospectors.

The Stone Manufacturing & Building Co. of Des Moines, Iowa, filed articles of incorporation with the county recorder December 2, and will commence business in Des Moines at once. The incorporators and stockholders in the company are John Brown and G. W. Williamson of Cincinnati; J. M. Brenton, N. E. Coffin, E. M. Sandford, A. H. McVey, Elizabeth K. Stanley and Mrs. M. E. Simons of Des Moines, and Nathaniel Schee of Oskaloosa. Authorized capital stock $100,000. The stone is made of cement and sand under pressure on a wood back, and as a rule is about four inches thick. This is put on buildings as a veneer by screwing the wood backs to the siding used in building.

AN AUSTRIAN INVESTIGATION OF MASONRY PIERS.

In 1897 the Austrian Society of Engineers and Architects appointed a committee of its prominent members to test the compressive resistance of masonry in large blocks and also to determine the strength of various floors. The tests on the compressive resistance of masonry have been completed, and the full report on them has been recently published. The following is an abstract of its technical part:

The famous tests on arches, made in an extensive scale by the Austrian Society, the report on which was published in 1895, have shown that the design and computation of masonry arches should be based on the theory of the elastic arch. But the second essential requirement of a correct design was still unfulfilled; namely, definite data as to the compressive resistance of masonry made up of stone and mortar. Only by the aid of these data are we enabled to determine the degree of safety a structure will have under given conditions. Owing to the scope of the tests under review and the great variety of materials employed in them the problem will be solved but very incompletely, but this investigation will certainly extend our knowledge in this direction and may become the incentive for further tests.

It was decided to test the following materials: Single granite and sandstone blocks; masonry blocks built of quarry-stones (sandstone), of ashlar masonry (granite and sandstone), of concrete, and of concrete reinforced by steel, of pier-bricks, ordinary bricks, and finally, of hollow bricks. Several proportions of mortar and of concrete were proposed for tests at different ages, and tests were to be made under central as well as under eccentric pressures. For each kind of masonry and each proportion of mortar two test prisms were proposed, and their dimensions were generally fixed at about 20x20 inches base and about 40 inches height. It was thought desirable to approach practice in preparing the test pieces in sets made with great care and sets made with less care, but the small number of tests and the practical difficulty of the proposition for comparatively small blocks did not favor it, and the tests were made on masonry supposed to be built carefully.

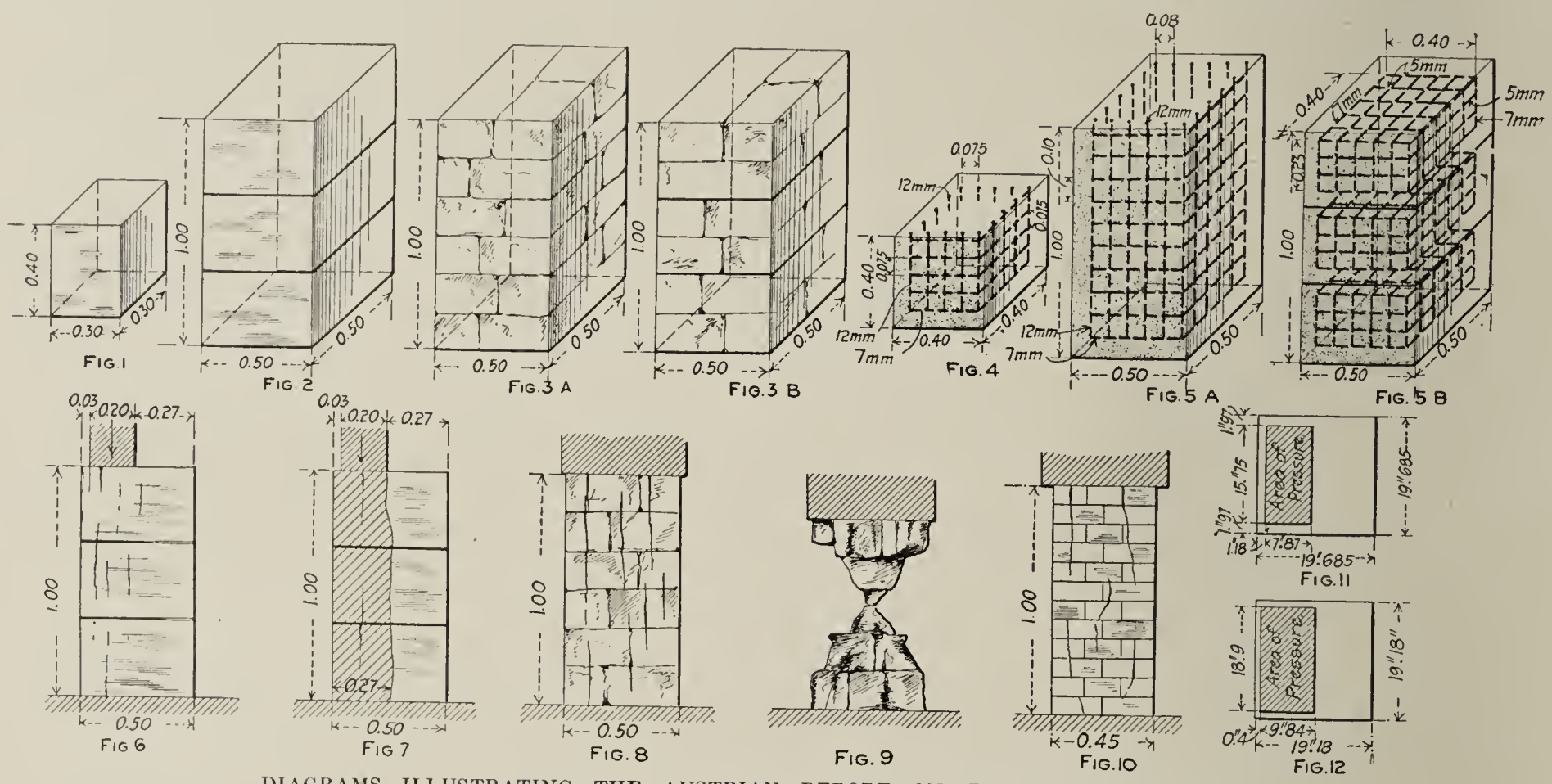
In Figs. 1 to 5 are shown types of the different specimens:

1. Single block, Fig. 1, and ashlar masonry, Fig. 2, of hard sandstone and granite. Both horizontal sides were polished to planes parallel to each other. The joints were $\frac{3}{4}$ inch and filled with mortar in the proportion of one volume of Portland cement to two of sand.

2. Broken stone masonry was made up of sandstone laid on its bed in mortar in proportions of 1:2 and 1:$3\frac{1}{2}$. The specimens of type A were built in strong wooden boxes, all in one piece. Those of type B were built in two operations. First, three artificial blocks were made up of stones in smaller boxes, using the above mortar proportions. These blocks were then left to harden for a month's time. After that period the three blocks were laid to make up specimens of type B. The joints of this composite block were again filled with mortar of the proportion 1:2. The series of tests characteristic of type B was intended to show the behavior of artificial blocks as they have been prepared for long-span arches in the report on arches. In making up the specimen blocks the wooden boxes were first leveled up carefully on a layer of sand and set vertically, and the laying of stones was begun with a good mortar bed. The stones were set against the walls, and the top was leveled off with a layer of cement. Any open spaces between the masonry and the walls were filled with a grouting of mortar. To prevent the adhesion of the masonry to the wood the latter was covered with a layer of linseed oil before the laying of the stones began. For the blocks of ashlar, quarry-stone masonry and bricks, a slow setting Portland cement was used exclusively.

3. The concrete blocks were made of Danube sand, gravel and Portland cement in the proportions of 1:2:3, 1:3:5 and 1:4:6. As above, types A and B were made.

4. The concrete-steel blocks, Figs. 4 and 5, were made of 1:$3\frac{1}{2}$ concrete. The arrangement of the round iron rods is different in type A from that in type B, as can be seen in the figures. In type A the vertical main-rods have a diameter of $\frac{1}{2}$ inch, and extend from plane of pressure to plane of pressure. They are connected by means of horizontal rings, 9/32 inch in diameter. In type B the main sets are laid parallel to the planes of pressure.



DIAGRAMS ILLUSTRATING THE AUSTRIAN REPORT ON TESTS OF PIER MASONRY.
(Dimensions are in meters except in case of Figures 11 and 12.)

5. Brick masonry was made of common bricks as well as of pier and hollow bricks. It was laid in mortar of proportions 1:2 and 1:3½. The same method of laying the bricks was used as for the stone masonry. The hollow bricks were laid with their holes vertical and filled with sand, except where unintentionally they were filled with mortar.

A hydraulic press capable of furnishing a slowly increasing pressure up to 1,320 tons was used for the tests. The press belonged to a steel works, which used it to compress steel blocks. A careful standardization of the press was made by the committee. The blocks were brought by a crane to the press and then were cleared of the mortar facing so that the cross dimensions could be measured at three different places; the height of the specimen was then measured. To level any remaining uneven spots in the two planes of pressure thin cardboard covers were used as a rule. In the case of more considerable differences a thin layer of fine sand, passed through a sieve, was used, so that in both cases a practically uniform distribution of the pressure was obtained. Most of the tests were made with central pressures, in opposition to the first intentions. This was due to two distinct causes. As will be seen below, no correct conclusion could be made on the compressive resistance of the specimens under eccentric pressures. Again, the longer time required for these tests, due to the required interchange of rams, made them objectionable as interfering too much with the operation of the steel works.

According to the material of the specimen the test was begun with a moderate pressure, which was then increased gradually up to the first sign of failure and finally to complete collapse. The beginning of failure was noticeable by a cracking sound, and could be seen by fine flakes peeling off of the surface and off of the edges. The characteristics of the first signs of failure cannot, however, be considered as completely reliable, because no precise fixing of the time and of the amount of pressure at which failure begins could be made with sufficient accuracy. But they, nevertheless, fix the instant at which the elastic limit of the body has been exceeded, and while not representing the full truth will be found to be of value. On the contrary, the instant and the amount of pressure at which the breaking down of the specimens took place was completely fixed, and the reading of the greatest pressure on the gauge could be recorded exactly.

Table 1 gives the detailed record of the tests. The tests of single stones of 1 foot square base show that the prevailing idea that granite must be considerably stronger than sandstone does not hold true in this case, as the limits within which the collapse took place were the same for both materials. The sandstone blocks showed, however, quite early the first signs of failure, while the granite completely failed and collapsed simultaneously with the first cracks, accompanied by an explosive sound and a breaking into small parts.

Table I, Details of Tests of Blocks, all Loaded Centrally except Nos. 5, 6 and 12:

No.	Description.	Proportion of mortar or concrete.	Age, mo's	Pressures, lbs. per sq. in. 1st signs of failure.	Break down.
	Single Stones, Fig. 1, 1 ft. square, 15¾ ins. high.				
1.	Granite, Note A...	...	...	10,866	10,910
2.	Granite	...	...	8,130	8,550
3.	Hard sandstone....	...	...	5,460	10,380
4.	Hard sandstone....	...	...	5,500	8,780
	Ashlar Masonry, Fig. 2:				
5.	Granite, Fig. 11 shows loading..	1:2	5	...	8,110
6.	Granite, Fig. 11 shows loading...	1:2	5	....	8,310
7.	Sandstone	1:2	5	Note B	....
	Quarrystone Masonry.				
8.	Hard sandstone in layers, Fig. 3a...	1:2	3½	2,760	3,220
9.	Ditto	1:2	3½	2,810	3,870
10.	Ditto	1:3½	3½	2,290	2,730
11.	Ditto	1:3½	3½	2,360	2,820
12.	Hard artificial sandstone in layers, Fig. 3b.....	1:2	6	....	3,540
13.	Ditto; Note C.....	1:2	6	2,580	3,510
14.	Ditto; Note D.....	1:3½	6	2,240	2,390
15.	Ditto	1:3½	6	1,860	2,190
	Concrete.				
16.	Made in one block,	1:2:3	3½	1,690	1,780
17.	Ditto	1:2:3	3½	1,450	1,850
18.	Ditto	1:3:5	3½	....	839
19.	Ditto	1:3:5	3½	655	977
20.	Ditto	1:4:6	3½	....	655
21.	Ditto	1:4:6	3½	....	668
22.	Made in 3 blocks..	1:2:3	6	1,350	1,780
23.	Ditto	1:3:5	6	1,180	1,180
24.	Ditto	1:4:6	6	796	863
	Concrete Steel Blocks.				
25.	Made in 1 block, Note E.....	1:3½	2	2,140	2,200
26.	Ditto	1:3½	2	2,090	2,930
27.	Ditto	1:3½	3½	2,420	3,780
28.	Ditto	1:3½	3½	2,530	3,910
29.	Ditto	1:3½	3½	1,980	3,800
30.	Ditto	1:3½	3½	2,110	4,220
31.	Ditto	1:3½	6	1,860	3,360
32.	Ditto	1:3½	6	1,990	3,340
33.	Ditto	1:3½	6	2,390	4,180
34.	Made in 3 blocks..	1:3½	4½	1,640	1,850
35.	Ditto	1:3½	4½	2,120	2,260
36.	Ditto	1:3½	6	1,540	1,950
37.	Ditto	1:3½	6	1,650	2,450
	Brick Masonry.				
38.	Paving brick.....	1:2	3½	2,520	3,770
39.	Ditto	1:2	3½	2,840	3,820
40.	Ditto	1:3½	3½	2,640	4,210
41.	Ditto	1:3½	3½	2,840	3,820
42.	Paving brick laid in 3 blocks.....	1:2	6	2,400	3,370
43.	Ditto	1:2	6	2,380	2,660
44.	Hollow brick.....	1:2	3½	2,250	3,140
45.	Ditto	1:2	3½	2,360	3,630
46.	Ditto	1:3½	3½	1,910	2,290
47.	Ditto	1:3½	3½	1,930	2,380
48.	Hollow brick laid in 3 blocks.....	1:2	6	2,310	2,500
49.	Ditto	1:2	6	1,920	2,450
50.	Pier brick laid in 3 blocks.....	1:2	6	1,360	2,280
51.	Ditto	1:2	6	....	2,100
52.	Common brick.....	1:2	3½	555	1,450
53.	Ditto	1:2	3½	1,010	1,850
54.	Ditto	1:3½	3½	981	1,520
55.	Ditto	1:3½	3½	1,170	1,580
56.	Common brick laid in 3 blocks.....	1:2	6	1,540	1,850
57.	Ditto.....	1:2	6	1,350	1,440

Note A.—Nos. 1, 2, 5 and 6 showed very coarse fracsures.

Note B.—Test 7 could not be completed. At a pressure of 4,300 lbs. per sq. in., no signs of failure were noticeable.

Note C.—In the case of Nos. 12 and 13, the upper block became separated during transportation and only the remaining prisms of the specimens were tested.

Note D.—The mortar for binding together the three artificial blocks into one prism was mixed 1:2 for Nos. 12 to 14, inclusive, 22 to 24, 34 to 37, 42 and 43, 48 to 51, 56 and 57. These joints were four months old in the case of Nos. 34 and 35, and five months in all other cases.

Note E.—Nos. 25 to 28 were cubes measuring about 16 inches on each side.

Laboratory tests made by Building Councillor Hanisch on some sandstone cubes of the same quarry, 2.4 inches on each side, gave an average breaking resistance of 10,900 pounds per square inch, while analogous tests made on granite gave completely different results. The latter tests gave the average breaking resistance of granite as 19,400 pounds per square inch. But it must be stated that the granite used in the laboratory tests was very fine grained. The specific weight of the sandstone was found to be 2.55 and that of the granite 2.57.

The ashlar masonry of granite was tested under an eccentric pressure. These tests of Nos. 5 and 6, as well as the analogous test of quarry-stone piers, No. 12, proved to be of great interest. It is commonly assumed that according to the distribution of pressures the body fails either through the crushing of the edges or the opening of the joints, somewhat in the manner indicated in Fig. 6. This did not take place at all. Failure occurred more in the manner characterized by Fig. 7, and the opening of joints took place only in case of No. 6. No. 12 did not show even a flaking off of the mortar finish.

It hence follows that the failure of the masonry took place by a simultaneous shearing and crushing of the shaded area, and that in order to determine the breaking resistance the area on which the pressure was exerted directly must be taken in account. The results obtained in this way are very satisfactory; the tests, No. 12 especially, well agree with the values determined for central pressures. The behavior of masonry under eccentric pressure shows that while at small pressures the common theory of distribution of pressures in the joints and the values deduced from it for the computation of arches seem to be correct, the conditions are totally changed at the time of failure, and that the eccentric pressure is then uniformly distributed over the immediate area of contact. The remaining portion of the masonry exerts then no longer any influence, as otherwise the joints would undoubtedly have opened in all the cases tested, and failure of the mortar by tension would have taken place. Interesting as these tests under eccentric pressure proved to be, they were later dropped, because the determination of ultimate strength from central pressures furnishes more reliable data.

In all cases it was proved that the thin layer of mortar in the joints could not be crushed. Owing to some accidents the test piers of sandstone masonry No. 7 could not furnish data for the ultimate strength of the same. But referring to the uni-

form behavior of Nos. 1 to 4 it may be assumed that the ultimate strength of sandstone masonry is about the same as of granite masonry, Nos. 5 and 6.

The behavior of the quarry-stone masonry is characterized by tests of piers Nos. 8 to 15. They show a certain uniformity, inasmuch as the piers having mortar in the proportion of 1:2 gave better results than those with mortar of 1:3½. The higher age of the mortar in Nos. 12 to 15 proved to be of no influence, counteracted as it was by worse workmanship; No. 15 especially showed, after failure, poor stone laying.

Cracks appeared in the stones independently of the joints, Fig. 8, and increased in number with increasing pressure, and finally failure took place independently of the joints. As shown in Fig. 9, upper and lower wedge-shaped pieces remained standing after failure. These wedges were completely destroyed in themselves. It follows from this behavior of the quarry-stone masonry at the first appearance of cracks, as well as at final failure, that the masonry may be considered in the above cases as a homogeneous body of uniform elasticity and breaking resistance. Similar behavior was also shown by the brick masonry. The elasticity and the breaking resistance are, of course, dependent on the materials, the stone and mortar, but in no case is the strength of the masonry exclusively determined by the strength of one or the other of its constituents only.

The test piers of concrete, Nos. 16 to 24, gave uniform and quite unfavorable results. Failure took place rapidly and almost simultaneously with the first indications, and the tests of the poorer proportions of the concrete showed an almost complete disintegration of the body. The more favorable results of Nos. 23 and 24 are due to the higher age of the concrete.

The great influence of iron netting imbedded in concrete is shown by the tests of the Monier piers, Nos. 25 to 27. The piers of type A, with vertical rods extending from plane of pressure to plane of pressure proved to have a very great resistance, and it was not possible to attain the complete failure of the same. In all cases the vertical rods yielded first, then the external covering material gave way, and only then the failure of the inner portion could begin. The latter showed wide vertical cracks, but complete failure was never observed, owing to the excellent quality of the concrete used. It should be noticed that the horizontal rings which surrounded the vertical rods were held together at their ends only by thin wire. With the use of thicker horizontal rings and the welding together of their ends the yielding of the vertical rods, and with them the failure of the whole body, will be pushed much higher up. The shorter age of the cubes, Nos. 25 and 26, appears in the less favorable results. The tests on prisms of type B, Nos. 34 to 37, were, notwithstanding their greater age, less satisfactory than those on type A.

The tests on piers of paving bricks, Nos. 38 to 43, gave the highest resistance of all brick piers; the low result obtained with No. 43 is evidently due to the poor workmanship of this specimen. The behavior of the paving bricks was interesting, inasmuch as very fine cracks became visible even under low pressure, which is probably due to the rigidity of the material and to an incomplete uniformity of distribution of pressure. The figures in the table correspond to somewhat wider cracks, which would indicate the beginning of failure. The behavior of the piers of hollow bricks, Nos. 44 to 49, made a favorable impression; they showed great uniformity. The proportion of the mortar used proved here, as in the case of the quarry-stone masonry, to have an influence on the results, and, the same as in the case cited, the piers composed of three blocks, Nos. 48 and 49, gave correspondingly less favorable results. But it must be remarked that the hollow spaces of the individual bricks were completely filled with mortar, so that the whole body formed one solid mass.

The tests of pier-bricks and common bricks closed the series of tests of brick masonry, their strength being lower than the above-mentioned varieties. Each series of the former showed corresponding uniformity, though the difference in mortar proportion in tests Nos. 52 to 57 did not become apparent. Failure in both cases occurred quite rapidly. As in the stone masonry, the brick masonry showed cracks fully independent of the joints, Fig. 10, and here also wedge-shaped bodies remained standing after the collapse.

Attempts to measure the compressibility of the bodies gave no useful results; it was, however, established in some cases that in a gauged distance of 700 millimeters the compression reached a maximum of 1 millimeter. In other cases no measureable compression was found with the instrument used, which read to 0.1 of a millimeter. Frequently the collapse was so rapid that no measurement was possible. In order to make theoretic use of the amount of compression better instruments for measuring the same would have been necessary, which could well be had for laboratory tests, but not under the given circumstances.

To the conclusions and remarks already made above the following may be added: With few exceptions the tests have proved the great strength of masonry, compared to which the usual allowable working stresses appear to be very small. The influence of age did not prove, after the expiration of a given time, as important as it is generally held to be; on the other hand, the proportion of the mixture of the mortar used showed its influence in a whole series of tests. The tests of piers composed of artificial blocks, type B, give, as a rule, worse results than the similar results of piers of type A, made in one piece. This was due to the fact that the smaller artificial units were weakened by the manipulations of their laying after a hardening of four weeks. With materials of equally good quality the value and strength of our structures is in first time dependent on their workmanship during construction.

The usual tests of stone and mortar separately cannot be regarded as satisfactory and sufficient to base on them a reliable conclusion as to the strength of the mass composed of them. It is best in all cases of considerable structures to undertake tests on masonry blocks of as great dimensions as possible.

Table II gives the average compressive strength at the instant of failure of the various kinds of masonry tested. They have been deduced from the above results for

Table II.—Average Compressive Stress in Pounds per Square Inch, at Failure.

	Kind of masonry.	Mortar or concrete.	Resistance.
1.	Ashlar masonry of granite.....	1:2	8,110
2.	Quarrystone masonry of hard sandstone in layers.	1:2	3,550
3.		1:3½	2,560
4.	Gravel concrete.	1:2:3	1,780
5.		1:3:5	925
6.		1:4:6	711
7.	Concrete-steel in one block, Type A.....	1:3½	3,840
8.	Masonry of paving bricks.....	1:2	3,550
9.	Same of hollow bricks.....	1:2	2,845
10.	Same of pier bricks.....	1:2	2,130
11.	Same of common bricks.....	1:2	1,640

No. 1.—The test of sandstone ashlar masonry was omitted as being incomplete, but according to the above it may be taken the same as for No. 1.

No. 7.—The Monier piers of Type B give, as follows from the previous table, much less favorable results.

Nos. 8 to 11, inclusive.—For the brick masonry only mortar of the proportion of 1:2 was considered after it was found that the poorer mixture of 1:3½ did not show its influence in the series of tests.

Portland cement mortar three to four months old. It should be remarked that the compressive resistance alone is not decisive for the excellence and suitability of the different types of construction.

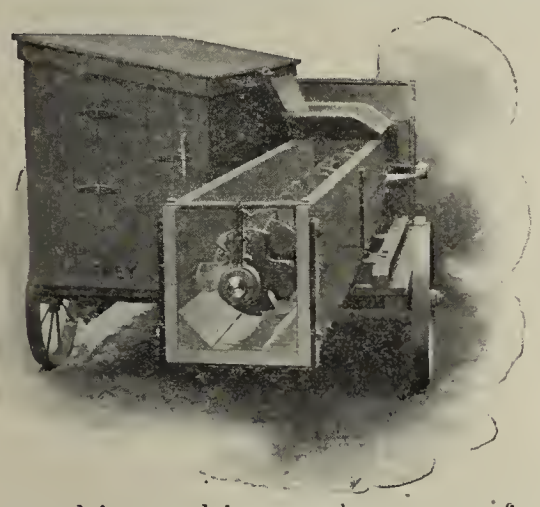
Interesting as the above tests proved to be, it became evident that the narrow limits within which they were undertaken are not sufficient to establish clearly the behavior of masonry under stress. Researches more extensive in time and in scope are required for this purpose, and only a scientific institute established for such purposes can afford an oppor-

tunity to accomplish them. No doubt the great saving which would be effected by a thorough knowledge of the materials of our structures would well repay the necessary expenses. The above tests are only a step forward; they are mainly intended to induce further research in this direction.—*Engineering Record.*

JEFFREY PORTABLE MORTAR AND CONCRETE MIXER.

The illustration herewith shows a new design of a mortar and concrete mixer. As a mortar mixer it is superior to any upon the market. The product is perfectly mixed and in that condition makes it possible for the brick masons to accomplish more work than when ordinary hand made mortar is used.

As a concrete mixer with slight modification in the form of the con-



veyor this machine makes a perfect product. When used for concrete the conveyor box is heavily lined with sheet steel.

The mixer is mounted on a substantial two-wheeled truck and made in two sizes. In one the conveyor is 12 feet long and 12 inches in diameter with mixing paddles every 6 inches.

In the second and larger mixer the conveyor is 14 feet long, otherwise the same as the smaller mixer. Both are equipped with a 3 H. P. gas engine.

For full particulars address the Jeffrey Mnfg. Co., Columbus, O.

The Atlas Portland Cement Co.'s mill No. 2 shut down on December 1 because of a defect in the fly wheel. The repairs may take several weeks. This mill contains 14 kilns and 28 pulverizers.

Attorney-General Bell of Texas has taken notice that the Acme Cement Co. and the Acme Cement Plaster Co., both of Acme, Tex., have been absorbed by the United Gypsum Co., which has a capital stock of $10,000,000 and seeks to control the plaster trade of the United States. The two Texas concerns will be prosecuted in the courts for alleged violation of the Texas anti-trust law.

The White Cliffs Cement & Chalk Co., White Cliffs, Ark., is preparing to open its works.

Duluth built twenty-six miles of sidewalk during the present season mostly of cement.

The Sandusky Portland Cement Co. has appropriated $250,000 for the enlargement of its plant at Syracuse, Ind.

The large steel corporations are reaching out for the scrap iron business which has heretofore centered at Cincinnati.

The Standard Oil Co. has awarded a contract for a steel tank steamer to the Trigg Shipbuilding Co. of Richmond, Va., to be used for conveying Texas oil to Philadelphia.

E. P. Manle, contracting engineer, is erecting a monolithic concrete building, four stories high at San Juan, Porto Rico, after the Ransome system "Twisted Iron" and Concrete Construction.

The German-American Portland Cement Co. of La Salle, Ill., has decided to double the capacity of its plant in order to reduce the cost of production. These improvements are now under way.

At the election of officers of the Michigan Portland Cement Co. at Coldwater, the following were selected: President, L. M. Wing; vice-president, Chas. Briggs; treasurer, Milo D. Campbell; secretary and assistant treasurer, E. R. Root.

Southern States Portland Cement Co. has been incorporated at Atlanta, Ga., with capital stock of $50,000, and privilege of increasing to $2,000,000, for manufacture of Portland cement, by H. F. Van Deventer, Nathan S. Potter and L. C. Fletcher.

Incorporated: Eastern Contracting and Agency Co., Augusta, Me. Capital stock, $10,000; general contracting, also buying and dealing in asphalt, cement and artificial stone, etc. Promoters, Jos. Williamson, Jr., I. L. Fairbanks, Augusta; E. J. McNulty, Boston.

United States Consul, Gen. Barlow of Mexico is preparing a directory of all business enterprises carried on with American capital in the Republic of Mexico, to be issued in book form by the United States department of state and distribute gratuitously to all applicants.

All interstate lines have published tariffs announcing an advance to the Kansas City basis, effective Dec. 1 in rates on cement to Texas points from Iola, Kan., and other points in Missouri, Kansas and Oklahoma Territory, which have heretofore taken less than Kansas City rates.

David Ford of Albion, Mich., has secured patents on a concrete railroad tie which will be tested on the Michigan Central railway roadbed.

The Davenport, Rock Island & Northwestern Ry. has prepared plans for a concrete sewer to be constructed at Moline, Ill., in order to be able to use a large area of land for track purposes, now intersected by a tailrace. The sewer is to cost from $25,000 to $30,000, not including the fill.

The McLaughlin Construction Co. of Kankakee, Ill., has just finished a concrete bridge across the Kankakee river within the city limits of Kankakee. A contest of more than a year was waged over the material to be used for this bridge by the citizens of Kankakee in which concrete was finally adopted.

Rapid progress is being made on the preliminary work for the St. Louis Portland cement plant at Fort Bellefontaine, Mo., on the Missouri river, near the Burlington road. The stone will be quarried at the point and shipped to Prospect Hill to be burned. It is said the plant will employ 250 men when completed.

The French bark General Mellinet arrived at Portland, Ore., Nov. 12. The vessel sailed from Dunkirk, France, June 8, having called at that port on the trip to Portland from Hamburg. She brought about 7,000 bbls. of cement, and all of it was discharged, and 93,000 bushels of wheat loaded for Queenstown.

A company has been formed to work the asphalt deposits on the banks of Rapid river, Delta county, Mich., under the name of The Michigan Oil & Improvement Co. C. C. Phelps of Green Bay, Mich., is secretary of the company. 5,000 acres of land have been leased by the company outright and 37,000 acres are held under options.

The Northwest & Central German Cement Syndicate has voted to dissolve at the end of 1902. The objects of this combine were to regulate the price and otherwise supervise the sale of Portland cement. It worked on a system of rebates to customers, the amount of rebate depending on the amount of sales for the season for each individual customer.

The Central Branch National Home for D. V. S., near Dayton, O., has advertised for the construction of 2,542 square feet of cement walks and 8,740 square feet of cement roadways. Bids must be made by the square complete. The work to be done between March 15 and May 30, 1902. Address A. J. Clark, treasurer, National Military Home, Ohio.

All of the wainscotings in the new summer school buildings at Topeka, Kas., are to be of cement, marked off to represent bricks and finished to imitate enamel.

Dr. Carl von Linde of Munich, Germany, has been granted United States patents on the liquid air process heretofore claimed by Prof. Tripler. Charles F. Brush of Cleveland, Ohio, has secured the right to operate Dr. von Linde's patents in the United States. Dr. von Linde says: "The American people are being fed with exaggerated ideas on the practical value of liquid air."

The Temescal Water Co. of Temescal, Riverside county, Cal., has awarded to Ormand & Miller of Riverside, Cal., the contract to construct four and one-half miles of cement ditch, the carrying capacity to be 800 inches. The ditch will form a portion of the new pipe and ditch line from Corona to Perris, Cal., and will take the place of the old ditch which was not improved when the remainder of the new line was constructed.

On December 5th fire completely destroyed the main building of the Michigan Alkali Co.'s soda-ash plant at Wyandotte, twelve miles from Detroit, Mich., entailing a loss of $500,000, on which there is an insurance of $250,000. Seven hundred men are temporarily thrown out of work by the fire. The plant will be rebuilt as soon as possible. This company manufactured the Wyandotte Portland cement from the waste product of its soda-ash plant.

Spreckels Bros. Commercial Co. is receiving large cargoes of cement from Europe consigned to San Diego, Cal. The Riversdale brought a cargo consisting of 20,000 barrels. The Siam 15,000 barrels. This filled the warehouse to overflowing. The Sierra Blanca and Formosa are waiting in the stream to discharge, having 12,000 and 13,500 barrels, respectively. As much as possible is being sent to the company's warehouses in Los Angeles, but this is hardly sufficient to relieve the situation.

The Pennsylvania Salt Co. is constructing all the foundation and basement walls of the buildings for their new plant in Wyandotte, Mich., of the highest grade of Portland cement concrete. The basement walls for the main building are between 1,200 and 1,300 feet in length and from 150 to 200 feet in width, are 4 feet thick and 14 feet 9 inches high, 4 feet 9 inches being above the grade line. The office building will cost $75,000 when complete, is now receiving its roof. This will be the first of the buildings in order of completion.

The Iola Portland Cement Co. is increasing the capacity of its storage warehouse by adding 100 feet to the present building. Sheldon H. Bassett, the president of the company, has been improving the system of manufacture by reducing the amount of water in the finished slurrey resulting in a large increase output per rotary. The grinding department has been placed under the supervision of an expert, resulting in economy on wear and tear and increased output in this department.

The Michigan Portland Cement Co. is to be reorganized upon the following lines: The company now has an issue of $1,500,000 common stock and a bond issue of $1,000,000. The plan decided upon is to reorganize the company with a capitalization of $1,000,000, with no bonded indebtedness, the stock to be all common stock. The only creditors outside of the bondholders are Holmes Bros., who form the American Construction Co., and as such erected the plant for which they now hold notes of the cement company for $200,000. They will surrender these notes and receive in exchange $80,000 in common stock in the new company.

The Assyrian Asphalt Co. of Chicago has confessed judgment for $112,648 in the United States circuit court. The indebtedness was in favor of James Keator, who holds a note for $100,500 and interest, given by the company to William Mackenzie on May 6, 1898, and conveyed to Keator. It is said to represent a cash loan made by Mr. Mackenzie to the company. J. P. Mallette was president at the time the debt was contracted. The company has an office in the Tacoma building, Chicago, and a plant at Grand Crossing which is still in operation. The company has been doing business in Chicago eight years. It is outside of the asphalt trust.

Plans are under way for the forming of an association of Western Portland cement manufacturers, to include in its control all the works in Michigan and in states west of Pennsylvania. The idea, it is said, is not to effect a combine at once, but to pave the way for the organization of a "community of interest arrangement." Territory will be distributed and competition will be eliminated as far as possible. Stockholders of the Newaygo Portland cement works are prime movers in the organization. Prominent stockholders of this company met at Grand Rapids on November 18 to promote the combine. Representatives of some of the biggest plants in the country were likewise present supporting the movement.

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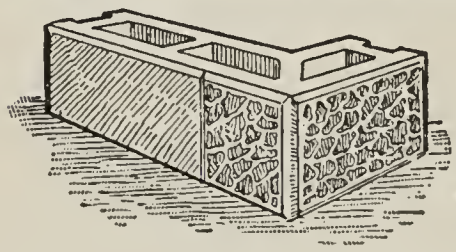

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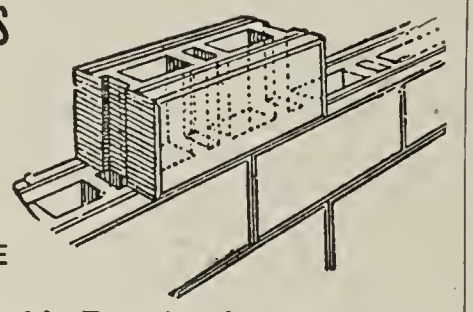

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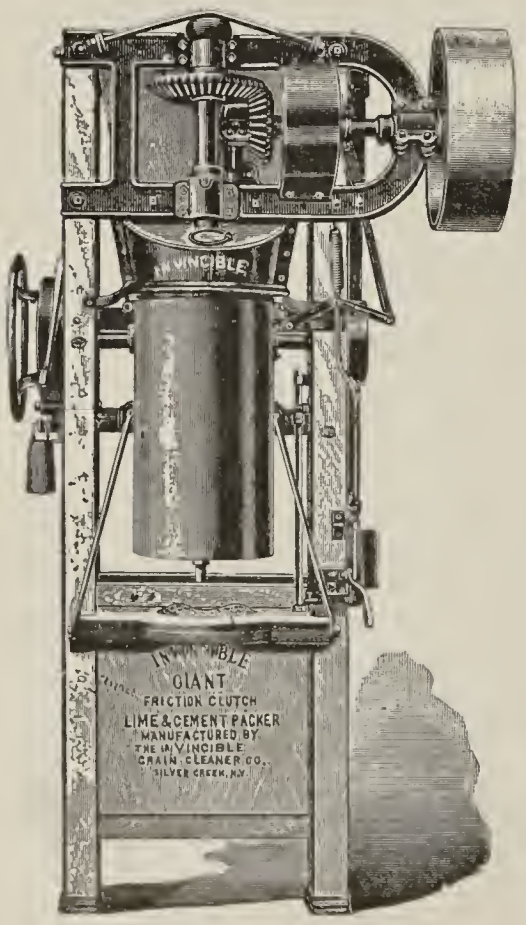

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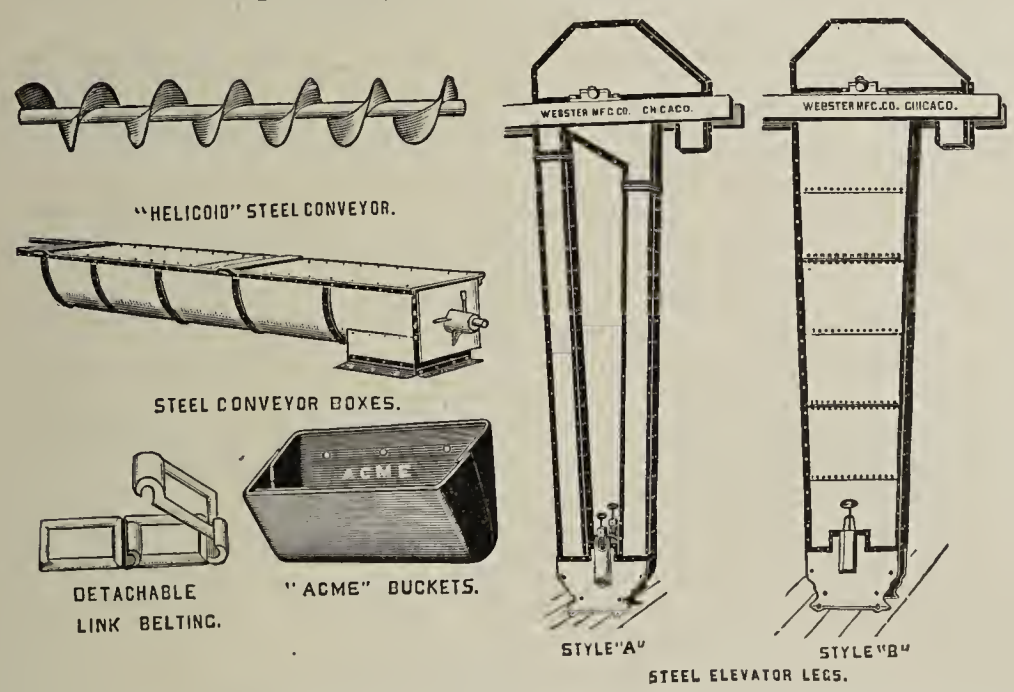

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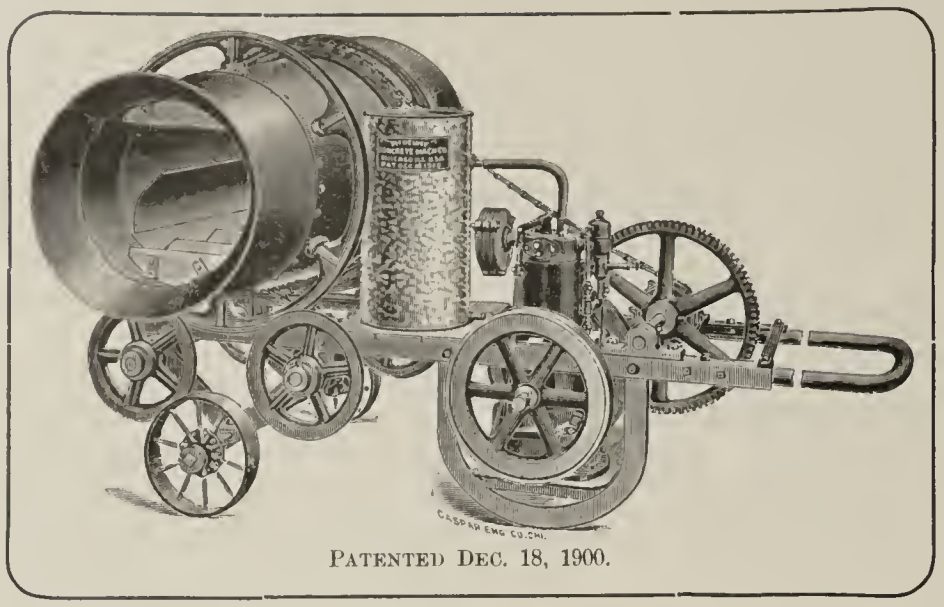

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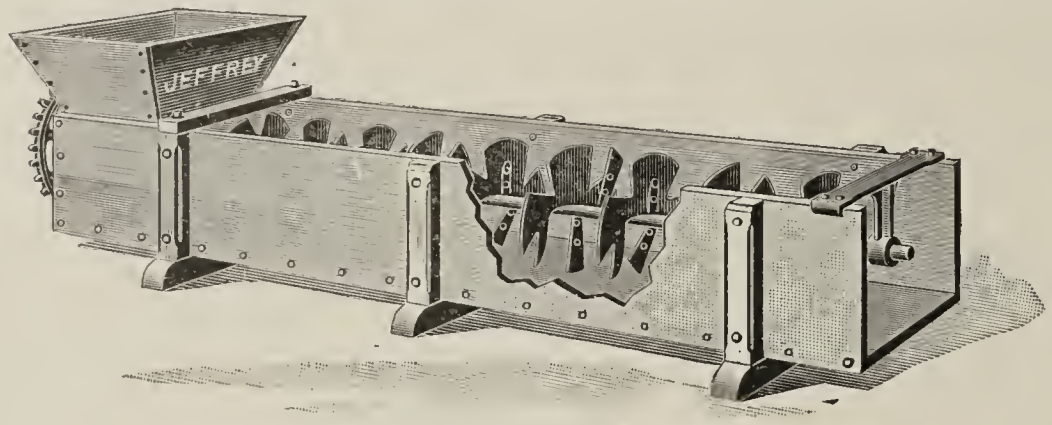

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